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ACID-BASE TOLERANCE OF THE CORNEA

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The present investigation is preliminary to a study of the mechanisms by which acids and alkalis damage the cornea. Previous work in this field has been relatively devoid of quantitative analysis. We feel that the prerequisites of a rigorous approach to this problem are: (1) the utilization of isotonic solutions of known p_H composed of simple acids, alkalis or buffer substances; (2) the separation of the physical factors of penetration from those purely chemical effects in which we are primarily interested, and (3) the elaboration of a numerical method of evaluating the severity of the reaction produced, so as to yield data which may be studied statistically and graphically.

METHODS AND MATERIAL

Solutions Used.—In order to have a buffer solution with essentially the same molecular composition over the entire range of p_H studied, we have used the following solution, which is similar to that described by Teorell and Stenhagen:[1] sodium citrate, 0.028 molar; potassium acid phosphate, 0.028 molar; boric acid, 0.028 molar; sodium chloride, 0.083 molar, and sodium hydroxide and hydrochloric acid, in varying amounts to bring about the desired p_H.

This buffer solution varies from a concentration isotonic with a 0.85 per cent solution of sodium chloride to a concentration one and a half times this tonicity. Saline solutions of this molarity do not damage the cornea. The nine dissociation constants of the three trivalent acids in the buffer solution are remarkably well distributed, and the titration curve (fig. 1) correspondingly shows effective buffering capacity over a wide range of p_H. These anions are well tolerated by living tissues, and this buffer solution has, therefore, been highly recommended for physiologic experiments.

For comparison at the extremes of acidity and alkalinity, we have used various dilutions of hydrochloric acid and sodium hydroxide made isotonic by the addition of sodium chloride.

Penetration.—Three series of experiments were performed.

1. Normal rabbit corneas were irrigated with the test solutions for ten minutes. A convenient head holder for rabbits, which allows the use of an ether cone during the experiment, is shown in figure 2. Two small spring clips attached to the upper lid of each eye and linked over the top of the head elevated the lids, and two bulldog clamps hanging on the lower lids exposed the cornea for irrigation. The corneas were kept bathed in the test solution by allowing 1 drop to fall from the buret directly onto the upper portion of the cornea approximately every two seconds.

2. The rabbit corneas were also irrigated after the removal of the corneal epithelium by application of ox bile or a 1 per cent solution of sodium glycocholate, or mechanically by means of a cotton pledget mounted on a toothpick and previously dipped in collodion.[2] As tested with fluorescein, the epithelium was removed most completely by the last method, and no corneal opacification resulted later.

3. One-tenth cubic centimeter of the test solution was injected directly into the corneal stroma with a 25 gage needle and a tuberculin syringe. Ether anesthesia was used in all expermients.

Numerical Methods of Recording Reactions.—The numerical method of quantitative evaluation of the severity of important disease manifestations has been widely used in vitamin studies,[3] having originally been used by Holst and Trøhlich, 1909 to 1910. This method was applied to estimation of the severity of anterior ocular lesions by Rothschild, Friedenwald and Bernstein.[4] It is easy to set up a scale of values for the severity of each symptom: For example, 0 may indicate absence of symptoms; 1, moderately severe symptoms, and 2, extremely severe symptoms. Or 0 may designate absence of symptoms, and 1 may indicate slight, 2 moderately severe, 3 severe and 4 extremely severe symptoms. After a number of lesions of varying degrees of severity have been observed, the major observable signs of the injury and the extreme range of expected variations can be established. Since variations in judgment may lead to moderate discrepancies in the classification of the severity of a single symptom in a given case, the judgment of the severity of the lesion

From the Wilmer Ophthalmological Institute of Johns Hopkins University and Hospital.

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will be less affected by subjective fluctuations if as many symptoms as possible are recorded independently, provided, of course, that the symptoms chosen are significant of the lesions and are not subject to wide independent variations from accidental causes, unrelated to the specific experimental lesion. For the present study, the significant symptoms were chosen for grading, and varying maximal values were assigned to them, the rating being dependent on their relative importance (table). The "duration" of the corneal opacity was included only in the final evaluation of a lesion. The ocular lesion exhibiting the most extreme degree of all recorded symptoms on this scale would have a grade of 40 points, and for graphic purposes this maximum lesion is represented as 100 per cent. Since perforation of the cornea represents maximum damage, such a lesion was rated as 100 per cent regardless of whether a lower figure was obtained by a summation of all the symptoms.

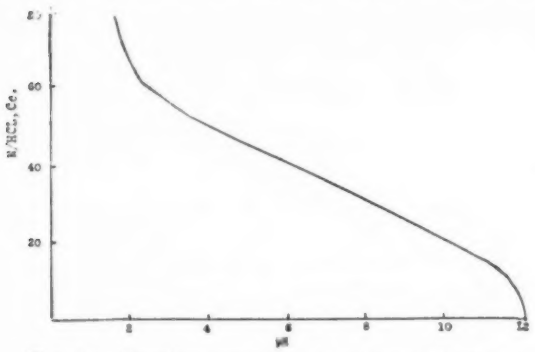

Fig. 1.—Titration curve for a "universal" buffer solution (citrate, phosphate and borate), taken from Teorell and Stenhagen.[1] There is a smooth, gradual change in p_H during titration, indicating effective buffering capacity between p_H 2.0 and p_H 12.0.

Numerical Estimation of the Severity of Lesions Produced in the Cornea of Rabbits' Eyes by Action of Corrosive Agents

Symptom	Maximum Grade, Points
Corneal opacity	
Intensity	8
Area	4
Less than one fourth of cornea = 1	
Less than one half of cornea = 2	
Less than three fourths of cornea = 3	
Over three fourths of cornea = 4	
Duration	4
1 to 3 days = 1	
4 to 6 days = 2	
7 to 13 days = 3	
14 days and over = 4	
Corneal edema or bulge (seen with hand slit lamp and loupe)	4
Corneal slough or ulceration	4
Denuded epithelium = 1	
Moderate slough = 2	
Pronounced slough = 3	
Perforation = 4 (100% lesion)	
Pannus (including density and length)	4
Conjunctiva	
Redness	2
Edema	2
Necrosis	2
Discharge	2
Iritis	4
Small pupil and photophobia = 1	
Congestion of iris or positive aqueous ray = 2	
Exudative iritis = 3	
Panophthalmitis = 4	
	40 × 2.5 = 100%

It is not to be assumed that a grade of 11 represents a lesion precisely 10 per cent more severe than a lesion with a grade of 10—any more than it is to be assumed that a student who obtains a grade of 90 knows precisely 20 per cent more than a student who has a grade of 75 per cent. Nor is it assumed that the same grade recorded at two different periods of the disease indicates an identical condition at those two periods. It is only assumed that, in a comparison of two lesions of the same age, the higher grade is attached to the more severe lesion.

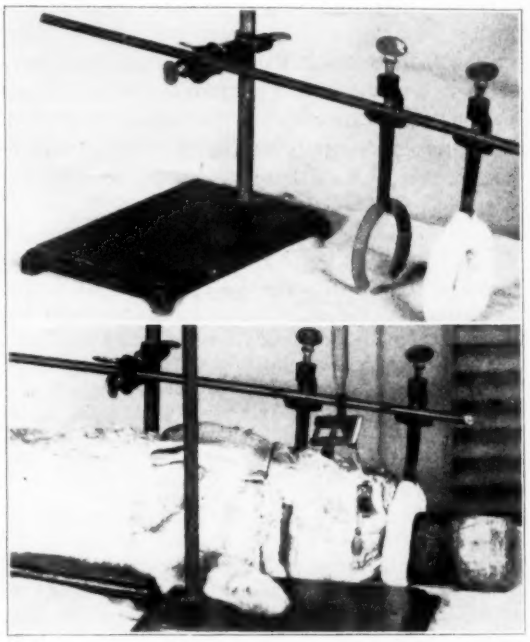

Fig. 2.—Apparatus for holding the rabbit under ether anesthesia during irrigation of the eyes.

In certain instances of intracorneal injection, irregularly scattered through the series, a peculiar corneal bulge developed which we attributed to accidental trauma, probably a too superficial injection. There appeared less ocular congestion, relatively less corneal opacity and more sharply localized areas of bulging in eyes exhibiting this bulge than in eyes with true corneal edema secondary to a toxic substance. At first values for eyes presenting this phenomenon were omitted from the analysis. Later it was found that if 3 was subtracted from the total score of symptoms for each degree of bulge, the effects of this accidental factor could be

left out of account. The final results are essentially unchanged whether the values for eyes showing this phenomenon are omitted altogether or are included with this correction.

RESULTS

The numerical system of grading lesions outlined here was found to give a useful estimate

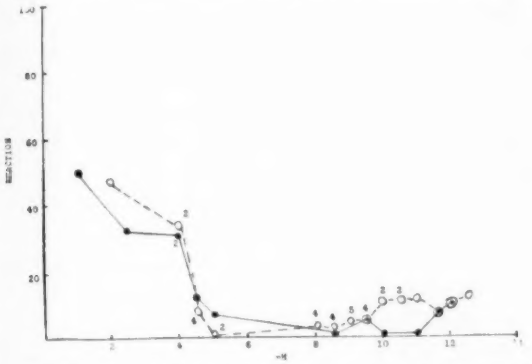

Fig. 3.—Graph showing the close approximation of the severity of the ocular lesions produced by two methods of exposure of the corneal stroma to buffer solutions of varying p_H. In this figure and in the following figures, the number beside each point plotted refers to the number of rabbit eyes tested to obtain the value for that point. The points without numbers represent one experiment.

The values obtained by removal of epithelium followed by irrigation are indicated by the solid line; those by intracorneal injection, by the broken line.

of the severity of lesions in over 400 eyes which had been subjected to various corrosive agents applied in different ways. The grades given by different observers for the same eye were remarkably close. Also, in determination of the lowest concentration of a toxic substance which would produce a corneal lesion, a series of eyes receiving increasing dilutions of the material showed a relatively smooth and proportionate reduction in the numerical grades. Values for the lesions produced by extremes in p_H were consistent.

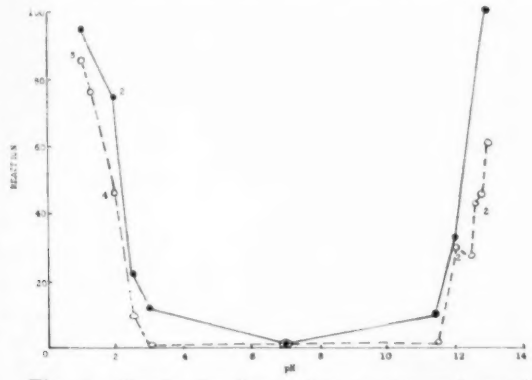

Fig. 4.—Graph showing a less pronounced reaction after intracorneal injection (broken line) of 0.1 cc. of an unbuffered isotonic solution of hydrochloric acid or sodium hydroxide than after continuous irrigation (solid line) of the eye with the same solution with the corneal epithelium removed. This difference in the reactions suggests a buffering capacity of the cornea itself.

Two methods for exposure of the corneal stroma to corrosive agents were used in these experiments: mechanical removal of the epithelium with a cotton pledget dipped in collodion followed by irrigation, and the intracorneal injection of 0.1 cc. of the test solution. The results with one method closely paralleled those with the other for the reaction of the eye to buffer solutions over a range of p_H 2.0 to p_H 12.0 (fig. 3). The rabbit cornea will apparently tolerate a solution of p_H 5.0. In several cases in which an alkali burn had resulted in loss of the corneal epithelium in the human eye, irrigation with an isotonic solution of acetate buffer with a p_H 4.7

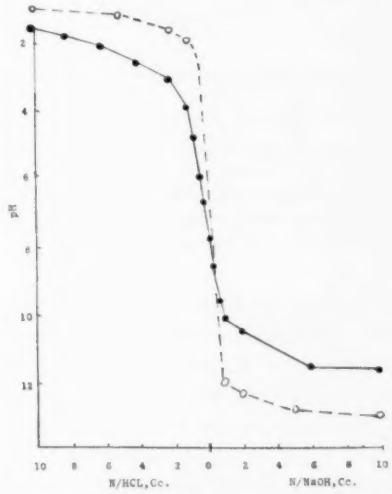

Fig. 5.—Curves for 5 beef corneas (solid line) titrated in a constant volume of 10 cc. of saline solution, a glass electrode being used for determination of the p_H. As compared with the titration curve for hydrochloric acid and sodium hydroxide (broken line), the beef cornea shows buffering capacity.

produced no visible damage. In the alkaline range, buffer solutions with a p_H up to 12.5 produced no severe damage.

Unbuffered isotonic solutions of hydrochloric acid and sodium hydroxide were used to determine the tolerance of the corneal stroma to extremes in p_H (fig. 4). Here it was found that the curves rose sharply at p_H 3.0 and p_H 11.5. It will be noticed that the reactions produced by the intracorneal injections of 0.1 cc. of the isotonic solution of hydrochloric acid or of sodium hydroxide were slightly less than those following irrigation. This suggests that there may be a slight buffering capacity of the corneal substance itself which would neutralize a small

amount of acid or base. Irrigation with large amounts of acid or alkali would overcome such a buffering action.

That the cornea does have a buffering effect was demonstrated by the direct titration of 5 beef corneas in a constant volume of 10 cc. of saline solution, a glass electrode being used for the measurement of the p_H (fig. 5). A comparison of the titration curve for the beef cornea with the titration curve for the isotonic solutions of hydrochloride and sodium hydroxide shows some buffering capacity for solutions below p_H 4.0 and those above p_H 10.0. The wet weight of 1 beef cornea is approximately 800 mg., and that of the rabbit cornea is 100 mg. The buffering capacity being assumed to be the same for the two animals, each rabbit cornea will theoretically require the following amounts, expressed in cubic centimeters, of tenth-normal hydrochloric acid or tenth-normal sodium hydroxide, in order that the corneal substance may reach the p_H values indicated:

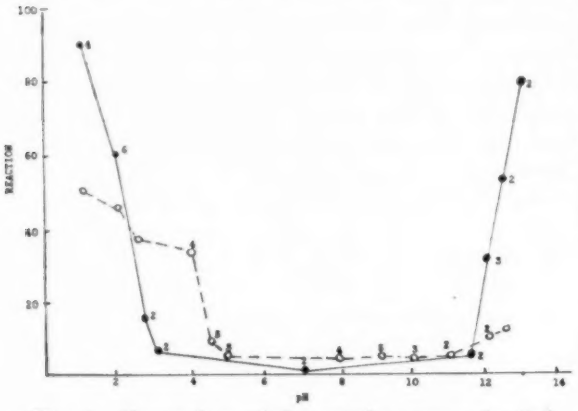

Fig. 6.—Comparison of the reaction curves for buffered (broken line) and for unbuffered (solid line) solutions. The limits of tolerance of the corneal stroma to unbuffered solutions of hydrochloride acid or sodium hydroxide are p_H 3.0 and p_H 11.5 respectively. "Universal" buffer solutions are tolerated only at a p_H above 4.5, an observation suggesting a greater affinity of the trivalent anions for corneal proteins.

Acid Range		*Alkaline Range*	
p_H	No. of Cubic Centimeters Required	p_H	No. of Cubic Centimeters Required
4.5	0.08	10.5	0.2
4.0	0.1	11.0	0.5
3.0	0.2	11.5	0.6
2.0	0.8		
1.5	1.0		

If it is assumed that the injected material reaches only one-tenth the corneal stroma, the effective buffering capacity of the cornea would be sufficient to account for the slight difference between the reaction curves produced by irrigation and those by injection of the test solution.

Comparison of the reaction curves of the corneal stroma for buffered and those for unbuffered solutions reveals a difference in their form (fig. 6). At both the acid and the alkaline extreme, the reaction produced by the action of the hydrochloric acid or the sodium hydroxide solution rises sharply outside the limits of p_H 2.5 or p_H 11.5. There is, therefore, a great increase in the corneal reaction for a very small change in p_H at these points. On the other hand, at both extremes in p_H the reaction curve for "universal" buffer solutions is much flatter. The reason for this protective action of the buffer solution is being investigated. From figure 3 it is seen that injection of a buffer solution produces a slightly more severe reaction than irrigation with the solution. This may be due to slow penetration of the large trivalent anions of the buffer.

On the acid side, moreover, reactivity is obtained at a higher p_H with the buffered than with the corresponding unbuffered hydrochloric acid solution, i. e., at p_H 4.5 as compared with p_H 2.5 (fig. 6). The explanation of this discrepancy is also the subject of current study, but it may be suggested that the greater affinity for proteins of the trivalent anions of the buffer solution may account for this difference.

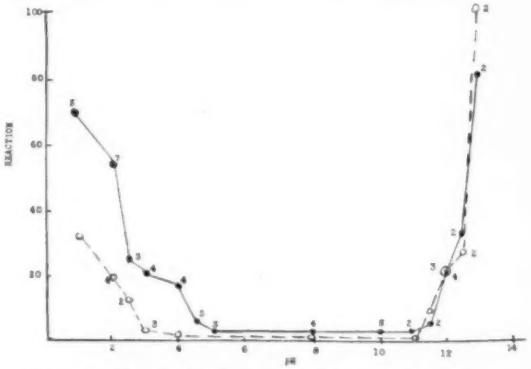

Fig. 7.—Chart showing protective effect of the corneal epithelium against a low p_H. At a high p_H the corneal epithelium is desquamated at the beginning of irrigation, and therefore no difference is found between the curves for simple irrigation and those for intracorneal injection or irrigation after the mechanical removal of epithelium. The values for the stroma are shown by the solid line; those for the intact epithelium by the broken line.

The protective influence of the corneal epithelium is demonstrated by comparison of the effect of irrigations with hydrochloric acid and buffer solution over intact epithelium with the

effect of these solutions when injected intracorneally or when used as irrigations after the mechanical removal of the epithelium (fig. 7). In the acid range this protective influence is pronounced. Application of ox bile or 1 per cent sodium glycocholate produces a diffuse punctate staining of the cornea but does not remove the epithelium completely. Irrigation with acid solutions after the use of bile salts has been found to produce a corneal lesion midway between that of simple irrigation with intact epithelium and irrigation after the complete removal of the epithelium by mechanical means. On the other hand, one of the first effects of irrigation with solutions of sodium hydroxide is swelling and desquamation of the epithelium. Hence the preliminary removal of the epithelium has less effect on the intensity of alkali burns.

SUMMARY

The applicability of the scale of grading the severity of corneal lesions produced by acids and alkalis has been demonstrated. The only important barrier to penetration of the substances used is the corneal epithelium. With buffer solutions and with isotonic solutions of hydrochloric acid or sodium hydroxide, it is possible to study the p_H tolerance of the cornea, but this is found to be not wholly independent of the ionic species used.

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MENINGOCOCCIC CONJUNCTIVITIS

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Although meningococcic conjunctivitis has long been recognized as a complication of cerebrospinal meningitis, its incidence has diminished notably in recent years with the introduction of antimeningococcic serum therapy. Thus, Randolph,[1] in 1893, cited Hirsch, Ziemssen and Hess as finding it an invariable concomitant of the cerebral disease. But, with the advent of serum therapy, no conjunctivitis occurred in a series of 66 cases reported by Lewis[2] in 1931 and was present in only 1 of a large number of cases reported by Tillet and Brown[3] in 1935. Cushing,[4] in 1940, was able to demonstrate only 4 instances of conjunctivitis among 124 cases of cerebrospinal meningitis.

Acute meningococcic conjunctivitis without any other clinical evidence of meningitis, or its development prior to the onset of meningitis, however, is not common at all, there being only infrequent reports of such an occurrence in the literature. Koplik,[5] in 1904, in a report of 77 cases of cerebrospinal fever, described only 1 case in which there was a history of conjunctivitis prior to the onset of meningeal symptoms, and Smith,[6] in 1905, reported another case of meningococcic conjunctivitis in a patient exposed to epidemic meningitis. McKee,[7] in 1908, posed the question as to whether the conjunctiva itself is an independent site of entry for meningococci or whether their presence there is secondary to that of similar organisms in the nose and throat, and in 1909 the same investigator[8] isolated the organism from the bacterial flora of a normal eye. Gifford and Day[9] reported a single case of meningococcic conjunctivitis without any other systemic manifestations, and Reese[10] described a case of conjunctivitis of meningococcic origin followed by meningococcic septicemia and abortive meningitis. Hayden and Hayden[11] reported single cases of meningococcic conjunctivitis occurring in one eye only and observed that the degree or course of the infection in their cases was not as severe as is commonly noted with gonorrheal conjunctivitis. This observation was confirmed by Clifton and Laird,[12] who described 2 cases of acute conjunctivitis of meningococcic origin unassociated with any other meningeal symptoms. In a report on meningococcic infection in soldiers, Daniels and associates,[13] in September 1943, studied 112 cases and mentioned as complications of the disease the occurrence of transient paralysis of the sixth nerve in 3 and of corneal ulcer in 1. In a similar report, made at the same time, Hill and Lever,[14] who studied 68 cases of meningococcic infection in soldiers, mentioned as complications transient paresis of ocular muscles in 50. In neither of these reports, however, was there any case in which meningococcic conjunctivitis occurred prior to the onset of meningeal symptoms.

The occurrence of meningococcic conjunctivitis is obviously of the utmost epidemiologic significance, and the following 10 cases, therefore, are all unusual in that they represent known

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instances of acute suppurative conjunctivitis of meningococcic origin.

REPORT OF CASES

CASE 1.—J. S., aged 14 weeks, was admitted to the hospital with edema and redness of the left eye of three days' duration, their onset being followed twenty-four hours later by a purulent discharge. Two days later the right eye became similarly involved. The patient had had a "cold" nine days prior to appearance of the ocular symptoms and was treated by a local physician, with subsidence of symptoms in two days. The past and family histories were noncontributory.

Examination on admission to the hospital revealed edema of the upper and lower lids of both eyes, with moderate conjunctival and pericorneal injection. Both eyes showed a moderate purulent discharge, but the corneas were clear. No general systemic symptoms or signs were present.

Smears taken from both eyes on the day of admission revealed the presence of many gram-negative intracellular diplococci, which on culture proved to be meningococci.

The patient was given sulfadiazine orally and placed under a regimen of irrigation of both eyes with a saturated solution of sulfanilamide followed by instillation of a 5 per cent sulfathiazole ointment.[14a] The swelling, redness and discharge gradually subsided, and the patient was discharged seven days after admission, with the process in both eyes quiescent and the appearance normal.

A follow-up examination in the clinic one week later revealed no pathologic signs referable to the eyes.

CASE 2.—A. D., aged 2 years, entered the hospital with a purulent discharge from the right eye for two days, followed one day later by the onset of discharge from the left eye. Smears taken at another hospital were said to reveal the presence of gram-negative intracellular diplococci. No other local or systemic symptoms were noted. The past and family histories were without significance.

Examination revealed some redness of the lids of the right eye, with profuse purulent discharge. The conjunctiva and pericorneal region were moderately injected. There was a slight purulent discharge from the left eye. The corneas of the eyes were clear. Examination, both local and general, revealed nothing else of significance.

Smears taken on the day of admission revealed gram-negative intracellular diplococci, which on culture proved to be meningococci.

The patient was given local therapy only, consisting of irrigations with a saturated solution of sulfanilamide followed by instillation of a 5 per cent sulfathiazole ointment. The redness and discharge gradually subsided; smears became negative, and the patient was discharged five days after admission.

A follow-up examination in the ophthalmic clinic one week later revealed that both eyes were normal.

CASE 3.—F. M., a youth aged 15 years, was admitted to the hospital with a history of edema and redness of the left eye, with suppurative discharge, for three days. Six days prior to admission he was said to have had a "cold," manifested by malaise and a serous discharge from the nose, the symptoms subsiding rapidly. The past and family histories were noncontributory.

Examination revealed moderate edema of the lids of the left eye, with pronounced conjunctival injection and profuse purulent discharge. There was edema of the epithelium, but no ulceration. The right eye was normal. The results of local examination were otherwise normal, and the general physical condition was good.

Smears of material from the left eye revealed many gram-negative intracellular diplococci, which on culture proved to be meningococci type I. The left eye was given local treatment, consisting of atropine and irrigations with a saturated solution of sulfanilamide followed by instillation of 5 per cent sulfathiazole ointment.

On the evening of the day of admission the patient complained of headache, malaise and nausea, with gradual elevation of temperature to 105.8 F. There were no signs of meningeal irritation at this time. By the following morning, however, the patient presented the clinical picture of meningitis, with stiffness of the neck, a bilateral Kernig sign and numerous petechiae scattered over the trunk and extremities. The heart, lungs and abdomen were normal. Lumbar puncture revealed elevated pressure; the fluid was cloudy and contained 984 cells per cubic millimeter, 94 per cent of which were polymorphonuclear leukocytes. A smear showed no bacteria. The white blood cell count was 33,000, with 92 per cent polymorphonuclear leukocytes.

Sulfadiazine was given intravenously, but its administration was followed in a few hours by the development of hematuria, and chemotherapy was discontinued. The temperature had meanwhile dropped to normal. Culture of material from the left eye and of the cerebrospinal fluid revealed a type I meningococcus. Treatment with intravenous injections of antimeningococcic horse serum and small intramuscular doses was started. Under this regimen, the temperature on the second day gradually rose to 102.5 F. and thereafter fell to normal, remaining so throughout the rest of the patient's stay in the hospital. A blood culture made two weeks later showed no growth, and lumbar puncture on the eighth day in the hospital yielded normal fluid. The course thereafter was uneventful, and the patient was discharged on the sixteenth day.

The left eye gradually improved during this period, becoming almost entirely clear six days after admission to the hospital. When it was examined at the time of the patient's discharge, the eye showed nothing abnormal.

CASE 4.—J. H., a boy aged 11 years, was admitted to the hospital with redness, swelling and photophobia of both eyes of four days' duration, the onset being followed one day later by a profuse purulent discharge. About six days prior to admission he was said to have had a mild infection of the upper respiratory tract. No other local and no general symptoms were noted. The past and family histories were noncontributory.

Examination revealed edema of the lids of both eyes, with pronounced conjunctival and pericorneal injection and profuse purulent discharge. Both corneas were steamy and displayed small superficial ulcers. Smears of material from both eyes revealed many gram-negative intracellular diplococci, which were shown on culture to be meningococci type I. The rest of the ocular, as well as the general, examination revealed nothing significant. The patient was placed under treatment, consisting of atropine and irrigations of a saturated solution of sulfanilamide followed by instillation of 5 per cent sulfathiazole ointment.

On the morning after admission the patient's temperature suddenly rose to 104.5 F., and he complained of malaise, nausea, chilly sensations and severe frontal headache. There were no signs of meningeal irritation, and physical examination revealed essentially a normal

14a. Five per cent sulfathiazole in a tragacanth-glycerin base.

condition except for the presence of a diffuse petechial rash over the trunk and extremities. The white cell count was 13,800, with 73 per cent polymorphonuclear leukocytes. A spinal puncture performed at this time revealed nothing of significance. The blood culture and culture of material from the throat, however, both yielded type I meningococci.

The patient was given sulfadiazine immediately, both intravenously and orally. Within twelve hours the temperature dropped to normal, remaining so for the rest of his stay in the hospital. His symptoms gradually subsided, and no meningeal signs developed. The corneal ulcers in both eyes gradually faded into superficial nebulas, and repeated smears were negative for bacteria. The patient had an uneventful convalescence and was discharged on the thirteenth day in the hospital. Ocular examination in the ophthalmic clinic one week later showed an essentially normal condition except for a faint central nebula in each eye.

Case 5.—V. S., aged 13 years, entered the ophthalmic clinic with a history of redness and purulent discharge for four days, which started in the right eye and was followed three days later by similar involvement of the left eye. There were no prodromal disturbances and no systemic symptoms. The rest of the history was noncontributory.

Examination displayed considerable conjunctival injection in both eyes, with profuse purulent discharge. The corneas of both eyes were clear, and the rest of the ocular examination revealed nothing abnormal. Smears displayed the presence of many gram-negative diplococci, and culture revealed a pure growth of meningococci type II.

The patient refused to go to the hospital and was sent home, with instructions to use simple irrigations of a solution of zinc sulfate. The redness and discharge gradually subsided, disappearing entirely in a week. When the patient was seen in the ophthalmic clinic, about three weeks later, there were no abnormal ocular signs.

Case 6.—R. H., aged 10 years, was admitted to the hospital with a history of swelling, redness and photophobia of the right eye, with purulent discharge, the appearance of symptoms being followed one day later by similar involvement of the left eye. There were no other local and no systemic symptoms. The past and family histories were noncontributory.

Examination revealed moderate edema of the lids of both eyes, with pronounced conjunctival and pericorneal injection and profuse purulent discharge. Both corneas displayed a faint central superficial nebula but no ulceration. Smears were positive for gram-negative intracellular and extracellular diplococci, and culture yielded a growth of meningococci type I. The rest of the ocular, as well as the general physical, examination revealed nothing significant.

The patient was given local therapy only, consisting of irrigations with a saturated solution of sulfanilamide followed by instillation of 5 per cent sulfathiazole ointment and atropine. The redness and discharge gradually subsided, and smears became negative for the diplococci. The patient was discharged on the tenth day in the hospital, with no abnormal signs except for the faint corneal nebulas, centrally situated in each eye.

When the patient was seen in the ophthalmic clinic one week later, the process in both eyes was quiescent, and there were no abnormal signs.

Case 7.—R. K., aged 6 years, was admitted to the hospital with a history of swelling and redness, with purulent discharge, in both eyes of one day's duration, the symptoms starting in the right eye and passing a few hours later to the left eye. No other symptoms, local or general, were noted. The past and family histories were noncontributory.

On examination, both eyes displayed pronounced conjunctival injection, with palpebral edema and profuse purulent discharge. The cornea of the right eye revealed a small, superficial central ulceration, and the cornea of the left eye, a central nebula with surrounding edema. Smears of material from each eye showed many extracellular and some intracellular gram-negative diplococci. Culture revealed meningococci type II. The rest of the ocular, as well as the general, examination revealed nothing abnormal.

Local and general therapy was instituted, consisting of irrigations with a saturated solution of sulfanilamide followed by instillation of a 5 per cent sulfathiazole ointment and atropine and oral administration of sulfadiazine. The corneal ulcer in the right eye gradually faded to a tiny superficial nebula, and the injection of and discharge from both eyes gradually subsided. On discharge from the hospital, ten days after admission, both eyes were normal except for faint central nebulas. Repeated smears were negative for bacteria.

When the patient was seen in the ophthalmic clinic, two weeks after discharge, both eyes appeared normal.

Case 8.—C. R., a boy aged 11 years, entered the hospital with a history of purulent discharge from the right eye for four days, accompanied by redness, swelling and photophobia. He stated that about one hour prior to the onset of symptoms a "piece of dust had been removed" from the right eye. One day prior to the onset of ocular complaints a "cold," manifested by nasal discharge and occasional sneezing, had developed. There were no other symptoms. The past history was interesting in that about eight months before he had been admitted to the hospital with a diagnosis of bilateral optic neuritis, followed by optic nerve atrophy. No cause for this condition was ever discovered, in spite of an extensive study of the case. The family history was noncontributory.

Examination on admission revealed edema of the upper and lower lids of the right eye, with pronounced conjunctival and pericorneal injection. There was a profuse purulent discharge. The cornea was clear. The fundi of both eyes showed optic nerve atrophy. The left eye was otherwise normal. Except for slight coryza, the general physical condition was normal.

Smears taken on the day of admission revealed the presence of many gram-negative intracellular diplococci, and meningococci type I were cultured. The patient was placed under local therapy only, which consisted of irrigations with a saturated solution of sulfanilamide followed by instillation of a 5 per cent sulfathiazole ointment.

The discharge ceased three days after admission, and injection gradually subsided. Repeated smears were negative for bacteria. The patient was discharged one week after admission, at which time there were no abnormal ocular signs except for the long-standing optic nerve atrophy.

Case 9.—W. H., a boy aged 11 years, entered the hospital with a history of purulent discharge from the right eye for three days, accompanied by redness, photophobia and occasional pain. He stated that one day prior to the onset of the ocular symptoms he had been "struck in the right eye by a football." There were no prodromal symptoms, and the family and past histories were essentially noncontributory.

Examination on admission revealed edema of the lids of the right eye, with moderate purulent discharge and pronounced conjunctival and pericorneal injection. There were numerous petechial subconjunctival hemorrhages, apparently secondary to the trauma sustained by the eye. The cornea was edematous but displayed no ulceration. There were a congenital defect of the iris and a congenital cortical cataract, confined to the segment of the eye corresponding to 11 o'clock. The ocular, as well as the general physical, examination revealed nothing else abnormal.

Smears taken on the day of admission revealed many gram-negative intracellular diplococci, from which meningococci type I were cultured.

The patient was given local therapy, consisting of irrigations with saturated solution of sulfanilamide followed by instillation of 5 per cent sulfathiazole ointment. The discharge cleared two days after admission and the edema and injection of the cornea and the subconjunctival hemorrhages gradually disappeared. The patient was discharged one week after admission, at which time there were no abnormal ocular signs except for the congenital defects.

CASE 10.—T. C., aged 7 months, was admitted with a history of discharge from the left eye, accompanied by redness and swelling, for three days. His mother noticed a slight improvement in the condition of the eye during the twenty-four hours before admission but definite signs of a "cold."

Examination of the left eye revealed deep injection of the conjunctiva and a purulent discharge. The right eye was normal. Smears revealed many gram-negative intracellular and extracellular diplococci.

General examination revealed essentially a normal condition. The temperature was 100.4 F. on admission. Cultures of material taken from the left eye and from the pharynx on admission revealed large numbers of type I meningococci.

The patient was given treatment for the eyes, consisting of irrigations with a saturated solution of sulfanilamide followed by instillation of 5 per cent sulfathiazole ointment.

Two days after admission the temperature became elevated to 100.8 F. The patient appeared somewhat groggy and hoarse. He refused food but took fluids well. Examination at this time revealed a slight discharge from the left eye and nose, slight coryza and inflammation of the pharynx; there were no petechiae and no Kernig sign. The spinal fluid taken at this time was normal. The white blood cell count was 13,950, with 55 per cent polymorphonuclear leukocytes.

In view of the bacteria present in secretions from the eye and pharynx, the boy was given sulfadiazine orally. The temperature remained elevated for two days longer, after which it dropped to normal and remained so for the rest of his stay in the hospital.

A culture of material from the pharynx taken two days before discharge was negative for meningococci. Smears and cultures of secretions from the left eye were also negative, and both eyes appeared normal on examination.

It is interesting to note that the mother became ill with a bad "cold" two days after the patient's admission to the hospital. Cultures of material taken from her pharynx at this time showed large numbers of type I meningococci.

BACTERIOLOGIC STUDY

Differential cultures were made in all the present cases and were directed especially toward the identification of gonococci and meningococci. The organisms were grown on (1) Mueller's starch [15] agar, in which gonococci grow especially well, and (2) Difco chocolate agar, prepared from Bacto Proteose no. 3 agar, which is particularly favorable to the growth of meningococci. Each medium had been recently prepared, and care was taken to be sure they had not dried out.

The plates were incubated in an atmosphere containing approximately 10 per cent carbon dioxide immediately after inoculation. The carbon dioxide atmosphere was obtained by burning a smokeless lighted candle in a sealed jar. The growth was often evident in twenty-four hours, but the culture was not considered negative for the bacteria until after incubation of at least forty-eight hours.

In instances in which the original culture was not pure, single colonies were transferred onto fresh plates. Transplants were then made from these pure cultures onto carbohydrate mediums and differentiated from other gram-negative cocci according to the usual procedure.

SUMMARY AND COMMENT

The 10 cases of acute suppurative conjunctivitis of meningococcic origin described here all occurred within a five month period (May to September 1943), and in none of them, as far as could be determined, was there any definite history of exposure or general prodromal symptoms. In 5 of the 10 cases the patient was said to have had a "cold" at some time prior to or at the time of the onset of the ocular infection, but this seemed to bear no definite relation either to the onset or to the course of the ocular symptoms.

The ages varied from 14 weeks to 15 years, and all the patients were males.

Of the 10 cases, frank meningitis (type 1) developed in 1, and meningococcic septicemia (type 1) with abortive meningitis, in another. Cultures of material from the eyes yielded type 1 meningococci in 4 other cases and type II meningococci in 2 cases. In the first 2 cases the organism was not typed.

Both eyes were involved in 6 cases and one eye only in 4 cases.

There was corneal involvement in 5 of the 10 cases, superficial ulcers developing in 2 cases and corneal edema alone in 3 cases. In none did a permanent residual ocular change follow therapy.

Treatment consisted of local and oral chemotherapy in 5 instances. Four patients received

15. Mueller, J. H., and Hinton, J.: A Protein-Free Medium for Primary Isolation of the Gonococcus and Meningococcus, Proc. Soc. Exper. Biol. & Med. **48**:330 1942.

local chemotherapy only, and 1, irrigations with zinc sulfate alone. The oral chemotherapy was given only in cases in which corneal involvement or systemic or meningeal symptoms were present. On the whole, neither the degree nor the course of the ocular infection seemed to be improved by the addition of oral administration of sulfadiazine, and the patient who received zinc sulfate alone did as well as the rest.

The average length of hospitalization (exclusive of the cases with meningeal involvement) was eight days, the ocular discharge subsiding in three to five days and the eyes becoming white and the process quiescent in seven days.

The apparent recent increase in the incidence of cases of suppurative conjunctivitis of meningococcic origin, previously considered of infrequent occurrence, leads one to believe that previous cases may have been missed because of the morphologic resemblance of the organisms to those in the neisserian group. The demonstration of gram-negative intracellular diplococci in the smear of a patient with acute suppurative conjunctivitis usually prompts one to suspect a gonorrheal infection. Differential cultures, however, will easily lead to the correct diagnosis—a factor of great importance when one is dealing with an organism of such potential epidemic virulence as the meningococcus.

NOTE.—Since the presentation of this paper for publication, a new case of meningococcic conjunctivitis has been reported by Reid and Bronstein,[16] and we have studied an additional case. In the latter the condition was limited to one eye and was due to the meningococcus type II. This organism was also cultured from material from the patient's pharynx.

243 Charles Street.

16. Reid, R. D., and Bronstein, L. H.: Meningococcic Conjunctivitis, J. A. M. A. **124**:704 (March 11) 1944.

DI-N-BUTYLCARBAMINOYLCHOLINE SULFATE

A NEW CYCLOPLEGIC AND MYDRIATIC DRUG

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Carbaminoylcholine chloride (doryl) does not affect the surface tension of water. Recently, we have synthesized surface-active derivatives of this compound by replacing the hydrophilic NH_2 group with water-insoluble amines, e. g., di-n-butylamine (fig. 1). This change in molecular structure and surface activity reverses the effects of the drug on the intraocular muscles. While the effects of carbaminoylcholine chloride simulate those of stimulation of the parasympathetic

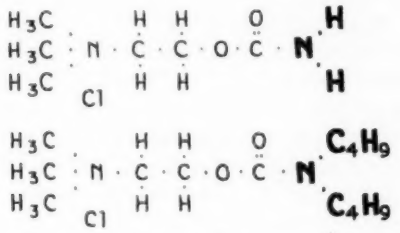

Fig. 1.—*A*, carbaminoylcholine chloride, and *B*, di-n-butylcarbaminoylcholine chloride.

nerves, i. e., miosis and cyclotonia, the action of the new surface-active derivatives simulates that of paresis of the parasympathetic nerves, i. e., mydriasis and cycloplegia. Synthesis and preliminary studies of the pharmacologic action of the new drugs on the eyes have been reported previously.[1] A more detailed investigation of the new class of drugs is the basis of this report.

It was our purpose to synthesize an improved cycloplegic and mydriatic drug for use in routine refraction and internal examination. For this purpose the tropine derivatives, i. e., atropine, homatropine and scopolamine, have many disadvantages, but there have been no substitutes. Ideally, the new drug should be readily available, inexpensive and chemically stable. It should have bactericidal properties, so that solutions would not require sterilization or addition of preservatives. Solutions should be nonirritating and effectively absorbed from the conjunctival sac. The dose producing maximal ocular effects by local application should be several times less than that required to produce minimal systemic reactions. Side effects on the eye, such as vasodilation, increased intraocular pressure and anesthesia, should be negligible. The drug should be nontoxic in therapeutic doses, its pharmacologic action consistent and its idiosyncrasies rare. Finally, the duration of action of the new drug should be short, so that patients will not have prolonged periods of visual disability as a result of ocular examinations. Of the new choline esters synthesized, di-n-butylcarbaminoylcholine sulfate most nearly meets these ideal requirements (fig. 2.).

Di-n-butylcarbaminoylcholine sulfate occurs as white, slightly hygroscopic crystals. It is practically odorless but has a bitter taste. The drug is synthesized by a relatively simple method from inexpensive and readily available chemicals. Dissolved in distilled water and kept in alkaline-free, dark glass bottles, it is stable at room temperature for weeks. Heat and light result in slow decomposition. As decomposition is usually associated with a shift in the hydrogen ion concentration from the acid to the alkaline side, it can be detected with litmus paper. Partially decomposed solutions become slightly irritating but are not toxic to the ocular tissues. A 7.5 per cent solution in distilled water is slightly acid and has

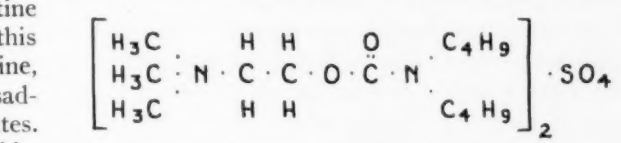

Fig. 2.—Di-n-butylcarbaminoylcholine sulfate.

an air-water interfacial tension of slightly less than 48 dynes per cubic centimeter at 25 C. Alkalis facilitate decomposure, but the new drug does not have the considerable chemical incompatibilities of the tropine alkaloids.

Solutions containing less than 4 per cent of the drug are bland, and concentrations of 4 to 7.5 per cent are only slightly irritating to the normal conjunctiva. Repeated instillations of 5 to 7 per cent solutions into the conjunctival sac may

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This investigation is part of a study being conducted under a grant from the John and Mary R. Markle Foundation.

1. Swan, K. C., and White, N. G.: Some Choline Esters with Cycloplegic and Mydriatic Action, Proc. Soc. Exper. Biol. & Med. **53**:164-166 (June) 1943.

create a transitory punctate disturbance in the epithelium, similar to that produced by other surface-active drugs, e. g., zephiran chloride.[2] These lesions rarely occur after the one or two instillations which are usually required for routine examination. They are perceptible only on biomicroscopic examination with the slit lamp and do not interfere with refraction or ophthalmoscopic examination.

Five per cent solutions of the chloride and the sulfate salt of di-n-butylcarbaminoylcholine were instilled two or three times daily into the conjunctival sacs of rabbits for one to three months. No evidences of injury to the intraocular tissues other than the epithelial changes already described were noted on biomicroscopic examination with the slit lamp or on ophthalmoscopic or histologic study.

A satisfactory chemical method of analysis of the ocular tissues for the drug has not been found; however, penetration of the cornea by the new drug seems to be consistent, as judged by the onset, intensity and duration of mydriasis and cycloplegia. In this respect the new drug differs from the related surface-inactive compound carbaminoylcholine. The latter penetrates the normal epithelium poorly.[3]

Experimental evidence indicates that the new drug produces mydriasis by paresis of the sphincter of the iris (atropine-like action), rather than by stimulation of the dilator fibers (epinephrine-like action). In the rabbit the mydriasis produced by the new drug is submaximal but becomes maximal on electrical stimulation of the cervical sympathetic nerves; therefore, the dilator fibers of the iris cannot have been stimulated effectively by the drug. In contrast, the drug blocks reactivity of the pupil to electrical stimulation of the oculomotor nerve; i. e., the drug has produced paralysis of the sphincter muscle. These experiments do not exclude the possibility that the drug has some effect on the dilator muscles; rather, they indicate that the predominant action of the drug is on the sphincter.

It is probable that the action of di-n-butylcarbaminoylcholine on the iris is the same in human subjects as in rabbits, causing paresis of the sphincter. The mydriasis produced by the new drug is submaximal and is increased by administration of epinephrine, which stimulates the dilator fibers but is unaffected by administration of atropine. The latter, like the new drug, produces paralysis of the sphincter. Cycloplegia produced in the human eye by the new drug simulates the cycloplegia produced by paresis of the oculomotor nerve.

The exact site of action of di-n-butylcarbaminoylcholine has not been established definitely; however, it is probable that the drug acts directly on the muscle cells, for it reduces reactivity of the sphincter of the iris to direct electrical stimulation, as well as to electrical stimulation of the oculomotor nerve. The action of di-n-butylcarbaminoylcholine on the intraocular muscles is antagonistic to that of pilocarpine, physostigmine and acetylcholine, but in combination with physostigmine it produces paresis of skeletal muscle in rabbits. Additional studies will be required to determine whether the new drug acts synergistically with atropine or other tropine derivatives. Cycloplegia produced by the new drug is not noticeably enhanced by paredrine hydrobromide, but mydriasis is increased.

Di-n-butylcarbaminoylcholine has been administered to the eyes of more than 700 patients over a period of a year and a half. One drop of a 7.5 per cent aqueous solution of the sulfate salt instilled into the conjunctival sac produced mydriasis and cycloplegia beginning in from twenty to thirty minutes and becoming maximal in fifty to seventy minutes. In contrast to the action of the tropine derivatives, in which maximal mydriasis and complete loss of the pupillary light reflex considerably precede and outlast maximal cycloplegia, mydriasis and cycloplegia produced by the new drug develop and wear off simultaneously.

The effects of the new drugs on the intraocular muscles remain maximal for approximately two to three hours, after which the effects wear off gradually. Seven to twelve hours after a single instillation the intraocular muscles usually react normally. With two instillations at ten to fifteen minute intervals the duration is several hours longer. In contrast, the cycloplegia, and particularly the mydriasis, produced by a single instillation of a 5 to 7.5 per cent solution of homatropine hydrochloride last considerably longer. The average emmetropic young adult receiving homatropine is able to read in eight to fourteen hours, but the visual near point does not return to normal for twenty to twenty-four hours. The pupil and pupillary reflexes usually do not return to normal for thirty-six to forty-eight hours.

The intensity of cycloplegia and mydriasis produced by a 7.5 per cent solution of di-n-butylcarbaminoylcholine sulfate was found to be equivalent to that produced by 5 per cent homatropine hydrochloride. A group of 74 young adults had refractions both with the new drug and with homatropine. The 148 eyes required an average

2. Swan, K. C.: Advances in the Medical Treatment of Glaucoma, Journal-Lancet **62**:79-82 (March) 1942.

3. O'Brien, C. S., and Swan, K. C.: Carbaminoylcholine Chloride in the Treatment of Glaucoma Simplex, Arch. Ophth. **27**:253-263 (Feb.) 1942.

of 0.04 D. less plus sphere with the new drug than with homatropine. The difference in the astigmatic correction was also insignificant. Minimal residual accommodation was determined by adding a + 3 D. sphere to the cycloplegic correction and determining the range over which the patient could read 0.5 print in good illumination. Residual accommodation, ranging from 0.6 to 1.5 D., was found with both drugs when single instillations were made and repeated in ten minutes.

Most patients found solutions of 5 per cent homatropine hydrochloride and 7.5 per cent di-n-butylcarbaminoylcholine sulfate to be about equally irritating; however, congestion of the conjunctival vessels was much more pronounced in the eyes receiving homatropine.

The new drug was not found to influence the intraocular tension of 50 normal adults, varying in age from 24 to 78 years; however, the drug produced a rise in intraocular pressure in 3 patients with suspected glaucoma simplex. The average maximal rise in tension produced by single instillations of a 7.5 per cent solution was 5.4 mm. Schiøtz, as compared with an average rise of 8.3 mm. produced by single instillations of 5 per cent homatropine hydrochloride. The rise in intraocular pressure lasted an average of nine and a half hours with the new drug, as compared with twenty-three hours with homatropine. It appears, then, that there is less danger of the creation of a rise of intraocular pressure with the new drug than with homatropine.

Di-n-butylcarbaminoylcholine sulfate has antiseptic properties which are lacking in the tropine derivatives. The new drug in concentrations of 0.1 to 0.3 per cent inhibits the growth of strains of staphylococci, pneumococci and alpha hemolytic streptococci isolated in cases of ocular infections. Concentrations of 0.5 per cent promptly sterilize twenty-four hour broth cultures of the same organisms.

The systemic pharmacologic effects of the new drug will be reported on separately; however, it is noteworthy that even in young children systemic symptoms are negligible after instillations of a 7.5 per cent solution into the conjunctival sac. The dry mouth, flushed skin, excitation of the central nervous system and depression which limit the dose of the tropine derivatives do not occur after instillations of the new drug into the conjunctival sac.

The pharmacologic action of di-n-butylcarbaminoylcholine sulfate is as consistent as that of the tropine derivatives. No idiosyncrasies to the drug have been noted in the 700 patients who have received the drug.

No allergic reactions of the conjunctiva or the skin of the lids of the "contact" type have been observed. The series of 700 patients is too small to be conclusive; however, it is noteworthy that contact dermatitis and conjunctivitis resulting from carbaminoylcholine or other choline esters have never been recorded, while contact dermatitis with tropine derivatives, particularly atropine, is not uncommon.

COMMENT

Clinical investigation of di-n-butylcarbaminoylcholine during the past one and a half years indicates that although this drug is less potent, it has some advantages over the tropine derivatives in routine internal examination of the eye and cycloplegic refraction. A combination of the new drug with one of the tropine derivatives may prove more effective than the use of either alone. The drug may also have advantages in the treatment of ocular inflammations; final evaluation will require considerable experimental work, as well as extensive clinical trial. Preliminary investigations indicate that the new drug has potent bactericidal properties and actions on the blood-aqueous barrier which are lacking with the tropine derivatives.

Di-n-butylcarbaminoylcholine sulfate is the most promising of the new choline-like derivatives to have an extensive clinical trial; however, the possibilities for development of more effective derivatives in this new field of pharmacology have not been exhausted. The most promising new compounds are surface-active, nitrogen-substituted carbamic acid esters of diethylaminoethanol. One of these compounds is the di-n-butylcarbamic acid ester of diethylaminoethanol hydrochloride. This compound has strong mydriatic and cycloplegic action but is more irritating than the corresponding quaternary ammonium derivative.

SUMMARY

We have recently synthesized a new class of choline esters with mydriatic and cycloplegic properties. Of the new drugs, di-n-butylcarbaminoylcholine sulfate most nearly meets the ideal requirements for use in cycloplegic refractions and routine internal examination of the eye. While less potent than homatropine in equal doses, the new drug has several advantages, notably, shorter action and negligible systemic effects from ocular administration.

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HEALING OF THE IRIS IN RABBITS FOLLOWING EXPERIMENTAL IRIDECTOMY

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Surgical iridectomy has been used to advantage in treatment of a variety of conditions in the human eye. It has been employed rather widely in selected cases of glaucoma, in conjunction with removal of the cataractous lens and for the purpose of making artificial pupils. The prolonged or permanent gain from such a procedure has been explained by the assumption, based largely on clinical observation, that under its usual conditions the iris tissue does not show evidence of ability to regenerate, and, further, that under aseptic conditions the iris in its normal environment does not appear to produce connective tissue with which to form a scar or to fill in a surgically made defect in the iris.

Collins and Mayou [1] expressed the belief that aseptic wounds of the iris, such as are made in a surgical iridectomy showed no tendency to formation of scar tissue and that, except for the absorption of blood, the appearance of the iris wound remained precisely the same as when it was first made. They did not note any extension around the cut surfaces of the endothelium of the anterior surface or of the pigment epithelium of the posterior surface. Also, according to Parsons,[2] there is no formation of true scar tissue in the iris after a wound is made, although the gaping wound is usually filled with a blood clot, which later forms a granular mass in which fibers may be seen. It was also stated by Parsons that "uncomplicated wounds of the iris have had scant attention, and it is probable that important facts might be discovered by reinvestigation."

It was in an effort to find out the nature and type of healing which does take place after iridectomy that the surgical and laboratory procedures described in this paper were undertaken.

This work was done at the Animal Experimental Institute of the Mayo Foundation, Rochester, Minn.

Submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfilment of the requirements for the degree of Master of Science in Ophthalmology, November 1938.

1. Collins, E. T., and Mayou, M. S.: Pathology and Bacteriology of the Eye, Philadelphia, P. Blakiston's Son & Co., 1925, p. 383.

2. Parsons, J. H.: The Pathology of the Eye, New York, G. P. Putnam's Sons, 1904, vol. 1, pt. 1, p. 287.

COMPARATIVE ANATOMY OF THE IRIS IN RABBIT AND IN MAN

The iris in the rabbit is rather similar to the iris in man in that it has a loose, cellular stroma containing vessels, nerves and unstriped muscle. Under normal conditions there is a small amount of fine fibrous tissue, which has branching spindle-shaped and star-shaped cells with elongated, interlocking processes. In the white rabbit, with blue irises, few or no pigment granules are seen in the sections stained with hematoxylin and eosin.

Briefly, the larger vessels in the iris run generally in a radial direction except for the circulus arteriosus iridis minor (called the circulus vasculosus iridis minor by Mann [3] because of its arteriovenous anastomosis), which lies not far from the pupillary edge. In the region of the ciliary body lies the circulus arteriosus iridis major. The arterial vessels of the iris belong to the ciliary system and are derived, in the rabbit, from the internal ophthalmic artery.[4]

The vortex and the ciliary veins [5] drain the venous blood from the iris, the ciliary body and the choroid. These veins empty into the orbital veins, which have three outlets: (1) backward, into the cavernous sinus and the intracranial system; (2) forward, through the facial system, and (3) downward, through the pterygoid plexus. While in man the return of venous blood of the orbit is largely into the intracranial system, in the lower mammals the return is more and more to the extracranial system.[2]

Near the pupillary margin the stroma of the iris carries, in its posterior portion, and sometimes in its middle part as well, a ring of unstriped muscle, the sphincter iridis. Endothelium covers the anterior surface of the iris, and a double layer of epithelium, the posterior surface, their union being at the pupillary margin.

3. Mann, I. C.: The Development of the Human Eye, London, Cambridge University Press, 1928, p. 225.

4. Duke-Elder, W. S.: Textbook of Ophthalmology, St. Louis, C. V. Mosby Company, 1934, vol. 1, p. 188.

5. Duke-Elder,[4] p. 144.

According to Fuchs,[6] the iris may be divided for convenience into two regions: the pupillary zone, central to the circulus minor, and the ciliary zone, peripheral to it. The ciliary zone, in turn, can be divided into a smooth part and a folded part, with one to seven concentric furrows, which are present on dilatation of the pupil. The iris in situ varies considerably in shape, the form depending on its state of contraction; in the fixed state the appearance varies with the area examined and the angle at which the section is cut.

In the rabbit eye small, ciliary-like, radial processes frequently extend along the posterior surface of the iris from the region of the ciliary body for a distance 1 to 2 mm. inward from the root of the iris. Near the limbus these radial processes give an appearance of fairly long, finger-like projections, and sometimes there are connecting circular ridges, which in cross section show a lattice-like formation. With the hematoxylin-eosin stain these processes of the iris and their connecting ridges appear to be similar in type and structure to the ciliary processes.

The anterior surface of the iris in the rabbit is relatively regular and smooth and contains no appreciable wrinklings or furrows in the fixed state if the pupil was small when the tissue was fixed, while in the human eye the anterior surface contains multiple small crypts.

It was observed that the diameter of the floor of the iris in the rabbit eye is considerably larger in proportion to the other gross measurements of the globe than that in the human eye. A typical iris floor in the adult rabbit eye measured 12 mm. in the vertical and 13 mm. in the horizontal diameter, while the globe measured 15 mm. anteroposteriorly, 17.5 mm. horizontally and 16 mm. vertically in the fixed state. The average human iris measures approximately 11.6 mm. in the horizontal and 10.6 mm. in the vertical diameter, while the anteroposterior diameter of the human globe is 24.3 mm., its transverse diameter 23.6 mm. and its vertical diameter 23.3 mm.

HEALING IN THE IRIS

In the classified scientific literature only one reference to original work dealing with the healing processes in the iris was found. This study was made by Papagno,[7] who observed that linear injuries through the full thickness of the iris may heal. He expressed the belief that miotics materially aided the healing of radial injuries and that mydriatics assisted the process if the slit was parallel with the sphincter muscle.

The effects of temperature and of various drugs and endocrine substances on cultures of iris tissue in vitro have been studied rather extensively in recent years. Sanjô,[8] in 1932, determined the influence of morphine, narcotine, papaverine and thebaine on the growth in cultures in vitro of epithelial cells of the iris and described the histologic changes in these tissues produced by these drugs. Such studies seem to indicate that iris tissue in vitro is affected considerably by the physical and chemical qualities of its environment. I do not know what part the chemical composition of the aqueous plays with respect to the power of the injured iris to regenerate or grow in vivo.

SURGICAL AND LABORATORY PROCEDURES

In order to ascertain the nature and extent of the healing processes which take place in the iris after surgical iridectomy, an experiment was carried out in which the eyes of large mature white rabbits were used.

These rabbits appeared healthy and received an ample ordinary diet for caged rabbits, both before and during the experiment. Except for infections of the respiratory tract, "snuffles" and pneumonia, pregnancies and a fatal injury from fighting, the physical condition of the animals remained generally good. The most frequent complication was snuffles, which is not surprising, as the experiment was carried out during January, February and March of a severe Minnesota winter.

After being received for the experiment, each rabbit was examined with regard to its general condition and for ocular anomalies or peculiarities. Each animal received an external ocular and an ophthalmoscopic examination. If the rabbit was accepted for the experiment, a metal number tag was placed around the neck by means of a metal chain, which was bradded on for continuous wear until disposal after enucleation.

At the time of operation meticulous care was taken to prevent infection and to devise and use a standard uniform surgical technic which offered the minimum amount of trauma and irritation to the ocular tissues.

Incisions were made in the limbus with a keratome, and a small toothless iris forceps was used for grasping the iris. Intraocular irrigations were not employed because of their possible irritative effect. If during the operation the anterior chamber filled with blood, gentle, persistent stroking of the cornea was carried out in an effort to remove the blood or the blood clot. After the operation no instillation was made or dressing applied. (On rare occasions early in the study the lids were sutured together, but this measure did not prove of aid, for the animal was considerably annnoyed

6. Fuchs, E.: Textbook of Ophthalmology, translated by A. Duane, ed. 5, Philadelphia, J. B. Lippincott Company, 1917, p. 27.

7. Papagno, M.: Alcune ricerche sul processo di riparazione delle ferite iridee (studio sperimentale ed istologico), Rassegna ital. d'ottal. **3**:17-27 (Jan.-Feb.) 1934.

8. Sanjô, K.: Influence of Morphine, Narcotine, Papaverine and Thebaine on Growth of Epithelial Cells of the Iris in Cultures in Vitro and Histologic Changes in These Cells Produced by These Drugs, Folia pharmacol. japon. (Brev.) **14**:5-6 (March 20) 1932.

by the sutures and frequently scratched the region. Hence suturing of the lids was discontinued.)

Twice each week the rabbits which had been operated on were examined routinely with a focusing lens, a hand slit lamp and an ophthalmoscope and observations recorded.

Stated intervals were allowed to elapse between operation and enucleation. One globe was removed immediately after operation; 5 globes were removed at the end of a four day period, and the remainder, at regular weekly intervals of from one to eleven weeks inclusive.

Immediately after enucleation each globe was placed in a dilute solution of formaldehyde U. S. P. (1:10) and transferred in a separate bottle to the pathologic laboratory, where (after lateral calottes were cut) some of the globes were embedded in pyroxylin and others in paraffin.

The technic for embedding in pyroxylin was as follows: Each opened globe was passed in succession through a series of bottles containing 50, 70, 80 and 93 per cent alcohol, absolute alcohol and absolute alcohol and ether, and was allowed to stand in each for twenty-four hours. Then the specimen was placed in a thin (3 per cent) solution of pyroxylin and after forty-eight hours was transferred to a thicker (6 per cent) solution for two days. Later the specimen, embedded in the 6 per cent solution of pyroxylin, was placed under a bell jar in the presence of concentrated sulfuric acid until the pyroxylin appeared well "set." The sulfuric acid was removed and an open bottle of chloroform put in its place for twenty-four hours. After this the specimen was removed from the jar and placed in a dish containing equal parts of chloroform and cedar oil for forty-eight hours, being transferred later to clear cedar oil and allowed to remain forty-three hours or longer. The blocked specimen was then placed on the head of a Spencer rotary microtome, and sections were cut at a thickness of 8 or 10 microns.

With the globes embedded in paraffin a simpler routine was carried out. The specimen was placed in 95 per cent alcohol overnight and then transferred to acetone for six or eight hours. Next it was placed in toluene and paraffin, in equal parts, for one hour and then changed to fresh paraffin alone for two hours, before being embedded in the paraffin block.

The sections were stained with hematoxylin and eosin. The procedure was as follows: The sections were washed twice in 80 per cent alcohol and then with distilled water. A hematoxylin stain was then applied for five minutes, and the sections were washed in 1 per cent hydrochloric acid. After being washed in ordinary tap water, the sections were placed in a saturated solution of lithium carbonate and again washed with tap water. Eosin was applied for two minutes, and the sections were washed several times in 95 per cent alcohol. They were then placed in carboxylene and allowed to stand for four minutes before they were washed in xylene. They were then mounted with balsam and a cover slip applied.

GROSS OBSERVATIONS

During the period of observation there was no gross evidence of infection in any of the globes. In 4 eyes a thin, veil-like material seemed to bridge part or all of the surgical defect. In 1 of the eyes a suggestion of bridging appeared four days after operation. In 2 of the 4 globes gross bridging was apparent in seven days, and in 1, in fourteen days. In 2 of these globes small hemorrhages occurred immediately after operation, and in 2 a slight hemorrhage was noticeable for the first time on the fourth day after operation. These hemorrhages were all gradually absorbed. The 2 hemorrhages appearing at the time of operation had disappeared by the seventh day. One of the small hemorrhages noted on the fourth day had disappeared by the tenth day, and the other was not observed after the fourteenth day. Microscopic study revealed no evidence of the thin, veil-like bridging in these globes.

HISTOLOGIC OBSERVATIONS

Microscopic studies revealed mild rolling or retraction of the cut margins of the iris in a few of the globes, but on the whole the cut edges remained as they were immediately after operation. Four days after operation the iris was extremely edematous and in many sections measured as much as three times its normal thickness. On the seventh day the edema was less pronounced, and on the fourteenth day the amount was slight. Except in 1 globe, all edema of the iris had disappeared by the twenty-first day. Hemorrhages, also, were not noted microscopically in any of the sections after the twenty-first day.

A study of sections from various areas and levels of the surgical defect in 5 globes removed four days after iridectomy revealed in 3 an early, feeble effort to bridge the defect with tissue. In these sections a blood clot filled the defect partially or completely, on the surface of which there extended a few to a continuous layer of cells resembling epithelium or endothelium, while the loose meshes of the blood clot appeared to support a few scattered spindle-shaped cells.

An iridectomy wound seven days old showed an extension of connective tissue from the cut surface of the cornea into the injured processes of the iris which were in close contact with the wound. Also, extending from the wound was a small ridge of dense connective tissue, running along in close proximity to, and even adjacent to, the inner surface of the intact Descemet membrane for a distance of 0.75 mm. The corneoscleral wound appeared to be well healed with connective tissue. The iris showed moderate hyperemia and edema.

Sections from both globes on which iridectomy had been done fourteen days previously revealed mild hyperemia and edema of the iris, as well as extensions of corneal connective tissue into the iris stumps. One area showed a small bridge of connective tissue which appeared to reach down

and cover the peripheral notch of the surgical defect in the iris and was attached, farther inward, to the cut surface of the iris. In the other globe, on which two iridectomies had been performed, a band of connective tissue bridged the limbic arc from one corneal scar to the other. In the fixed state this band was in close proximity to the anterior capsule of the lens. At one point the band was divided, and a strand extended behind the lens, in close proximity to the posterior capsule. From a study of various levels it could be determined that this connective tissue came entirely from the corneal scar and extended inward through the surgical defect in Descemet's membrane. In one of the areas of the iridectomy, a thin single layer of epithelium lay on an old, partially absorbed blood clot. This bridge was very fragile and short. The healing process here was no more advanced than that observed four days after iridectomy. In this globe, in which considerable postoperative reaction was grossly apparent, there was also a greater proliferation of corneal fibrous tissue inward than in the other globes, and the remaining iris appeared slightly more edematous.

After these sections of the fourteen day old iridectomy wounds, no sections of the surgical defect taken at a later stage showed even traces of cells springing from the iris. (I was unable to determine whether, after the first feeble attempt of the iris at repair, the failure of the process to progress was due to an inhibiting influence of the aqueous or to lack of viability of cells springing from the iris or to some other, unknown factor.)

All the sections did continue to show the ability of corneal fibroblasts to pass through defects in Descemet's membrane into the cut or injured surfaces of the iris and its processes, as well as occasionally to send an independent extension as a small ridge or, as in the case of the globe with considerable postoperative reaction (which may have been a mild inflammatory response), as an actual band or strand.

In the globe enucleated twenty-eight days after iridectomy, the defect in the iris was mechanically plugged near the limbus by normal, healthy-appearing processes of the iris. These processes did not have damaged surfaces and, although lying directly against the cut margins of the iris, did not show any signs of becoming adherent to or of fusing with the cut edges. The iris in the region appeared normal, and no edema was present.

In a globe enucleated thirty-five days after iridectomy a stump of the iris exhibited rounded free margins and dense infiltration with connective tissue cells, clearly arising from the corneal scar at the limbus. In the second globe, removed thirty-five days after operation, in addition to the iridectomy, the lens had been removed by extracapsular extraction, and the capsule remained as a folded mass (resembling a ribbon in the section) in a part of the wound. The capsule appeared slightly swollen but otherwise intact, and fibroblasts had been unable to penetrate it. Hence the otherwise firmly healed wound had a defect corresponding to the capsular material, but a thin band of fibrous tissue had formed around the outer margin. The sections containing defects in the iris in eyes enucleated forty-two, forty-nine and sixty-three days after iridectomy showed no further healing. The iris in these sections was free from edema and hyperemia.

One of the globes removed seventy-eight days after iridectomy showed remnants of iris tissue embedded in the corneal scar. The iris retained its structural characteristics and was easily recognized, but was permeated with connective tissue cells, apparently springing from the corneal stroma.

The accompanying photomicrographs illustrate the appearance of the iris before and at several stages after iridectomy.

The normal control section (fig. 1) was taken from the region of the angle of the anterior chamber. The gross appearance of the globe was normal. The cornea was normal; the anterior chamber was filled with normal-appearing aqueous; the pupil reacted to light, and the iris, which was blue, showed no abnormality. Microscopic study of cross sections of the specimen revealed the stratified pavement epithelium of the cornea merging at the limbus with the epithelium of the conjunctiva. The vascularity (superficial marginal vessel loops) of the superficial layers of the cornea was seen in the region of the limbus. The corneal stroma was in orderly layers. The structureless Descemet membrane could readily be made out, as well as the single layer of endothelial cells, which on cross section appeared rectangular, with a slightly oval nucleus and abundant protoplasm.

The meshwork at the angle of the iris had been slightly disturbed on section but filled part of the depression of the scleral furrow. The tissue of the iris was normal in appearance. It was made up of a loose meshwork of stroma containing vessels, nerves and unstriped muscle. Its anterior layer of endothelium and its posterior surface, composed of a double layer of epithelial cells, were intact. A ciliary process extended

from the posterior region just opposite the angle of the root of the iris (fig. 1).

The eyes which presented the most significant early changes were those enucleated four days after iridectomy. Of these 5 globes, 3 showed small gross hemorrhages at the time of removal. Microscopic study of these 3 globes also showed blood clots in the area of the iridectomy. The anterior chamber was filled in all the eyes, and neither gross nor microscopic inspection revealed any leakage of the wound. Microscopic sections of these 3 globes showed an early attempt at organization of the blood clot in the surgical wound. There was considerable edema in the iris tissue in each globe. The endothelial cells which extended out on the surface of the clot appeared to do so with some degree of regularity, and the spindle-shaped cells within the body of the clot were extremely sparse and did not give definite evidence of their origin (fig. 2).

Forty-two days after operation the appearance of the region of the iridectomy wound had changed considerably. A dense old fibrous connective tissue scar, which had produced considerable indentation in the cornea, lay just beneath the conjunctival margin. The vascularity of the limbic region (superficial marginal vessel loops) was plain, and the proliferation of the connective tissue at the corneoscleral junction in a somewhat irregular fashion or layering was evident. A wide break occurred in Descemet's membrane, with each end curling slightly upward.

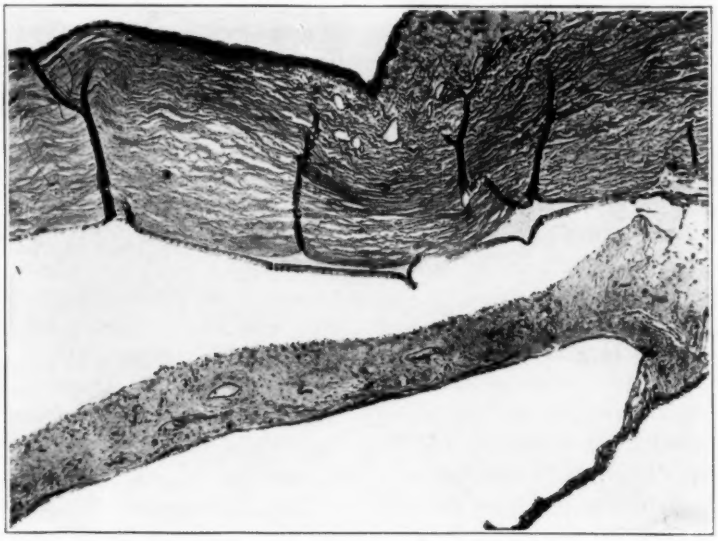

Fig. 1.—Normal cornea and iris in the rabbit (× 40).

Fig. 2.—Iridectomy four days after operation, showing edema of the iris and proliferation of endothelial cells into the blood clot filling the defect in the iris (× 40).

Proliferation of connective tissue appeared to fill in the gap between the two ends of this membrane. Below this gap, also, tissue and processes of the iris were adherent to the inner surface of the scarred cornea. There was no evidence of regeneration of the iris or of origin of fibrous connective tissue in the iris itself. Some processes of the iris and remnants of such processes were present below the adherent stroma of the iris. No evidence of hemorrhage was seen. A few lymphocytes were scattered in the scarred region, particularly near its surface (fig. 3 *A*).

Sections of the eyes seventy-eight days after iridectomy showed no striking change in the healing process. Here, again, there was no proliferation of fibrous tissue in the remnants of iris in the region of the corneal incision and the peripheral iridectomy wound. Some iris tissue was included in the wound, and the stroma had maintained its characteristics and had not formed dense fibrous connective tissue within itself, although it lay close to the fibrous tissue arising from the cornea and the sclera. The ciliary processes included in the area of the wound were hyperemic and distorted. Near the left central part of the section was a break in Descemet's membrane, with its characteristic outward curl of the ends. There was no evidence of regeneration of the membrane between these two ends.

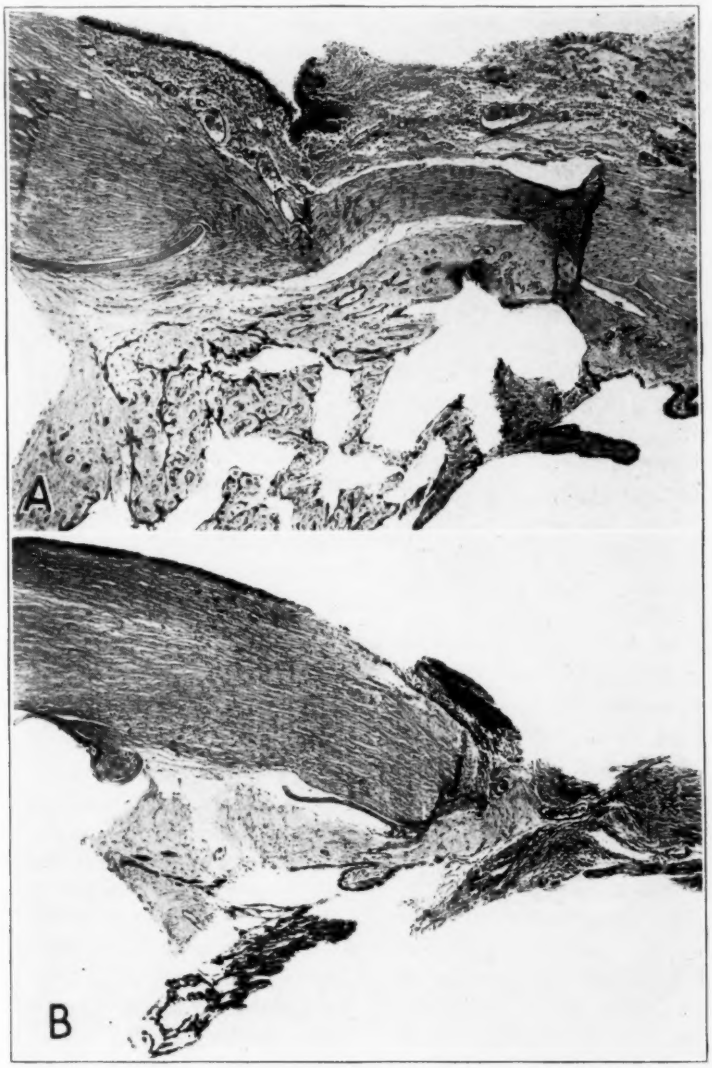

Fig. 3.—*A*, area of incision in the cornea, with the iris adherent to the cornea forty-two days after operation. *B*, corneal scar and fragments of iris in the region of iridectomy at the corneoscleral junction seventy-eight days after operation (× 40).

SUMMARY

In this study the following observations were made:

(1) Failure of iris tissue to regenerate itself after surgical iridectomy. (2) Failure of the iris of itself to bridge the surgical coloboma with permanent fibrous scar tissue, even though four days after operation 3 globes showed an early, feeble attempt to bridge the defect with a few scattered fibroblasts and a surface layer of epithelial or endothelial cells. Later no permanent bridging with tissue arising from the iris was observed. The tissue and the cut surfaces of the iris remained unchanged. (3) Frequent and prolific invasion of corneal fibroblasts into the approximated cut edges of the iris in the region of the wound. (Descemet's membrane appeared to function somewhat as a barrier. When it was perforated and the corneal stroma was cut in that region, the fibroblasts originating from the cornea could rapidly invade the damaged tissue or stump of the iris in that area.) This could, and did, occur in a moderate degree even when healing of the (incision) wound was rapid and firm, when the iris was not caught in the wound itself, and when there was no gross or microscopic evidence of infection or inflammation.

Medical Arts Building.

PARALYSIS OF DIVERGENCE DUE TO CEREBELLAR TUMOR

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There is no generally accepted opinion as to the mechanism of divergence in human eyes. Some authors (Duke-Elder,[1] Pugh, Alfred Graefe and others) have assumed that divergence is merely a passive function resulting from relaxation of convergence. Brouwer's theory of a convergence center located in Perlia's nucleus has almost universally been accepted (Riley[2]). The majority of observers find it difficult to believe that of all well regulated functions divergence alone should be without a definite innervation. If the limit of divergence were identical with a position of rest due to complete relaxation of convergence, every person who loses the ability of fusion ought to manifest divergent strabismus, whereas only a certain percentage do. Bielschowsky[3] stated that active divergence innervation is necessary to overcome esophoria. On the basis of neuromuscular physiologic observations, Bruce[4] stated that his conception of ocular divergence was that of a combined passive (i. e., elasticity of the external rectus muscles) and active function.

Knowledge of the centers and paths for divergence is even more scant. Although the proponents of active divergence function assume the existence of such a center, Bruce admitted "that reasoning will have to be guided by deduction rather than influenced by definite proof." He concluded that Hering's "faculty of attention" indicates the presence of a higher, cortical center. "The avenues connecting these higher centers with the lower ones are not well known."[4] It may be deduced that the "cerebral centers as well as the descending paths must be bilateral.[4]" It is conceivable that lesions in the cortical centers and in the descending bilateral paths cause paralysis of divergence, but other symptoms are likely to predominate. Pure divergence paralysis is likely to be caused by a lesion in a lower, subcortical center for divergence. There are on record cases of pure divergence paralysis in which true paralysis of the abducens nerve later developed. Bielschowsky, Bruce and others therefore postulated "the existence of a center for divergence separate from, but adjacent to, the nucleus of the sixth cranial nerve. Since the external rectus muscles are innervated only ipsilaterally, this nucleus would probably be in the midline."

Haessler,[5] in a recent review of this subject, differentiated between divergence as a "well established functional unit" and the "act of diverging." He expressed the opinion that divergence is possible as a "result of an orderly sequence of impulses to the individual muscles, just as fingers are moved . . . in such complex acts as playing a musical instrument." Divergence, accordingly, would not require a real center of preformed anatomic masses. Divergence would habitually be carried by the same neurons as a conditioned reflex. But Haessler expressed the opinion that the anatomic location of these neurons would also be in the brain stem. He admitted that the differentiation between an embryonically preformed center and these undifferentiated neurons is an academic question.

I shall not deal with the diagnosis or the differential diagnosis of divergence paralysis, since this paper is concerned with the evidence of a center for divergence. However, I shall list briefly the causes of divergence paralysis which have been mentioned in the literature (Prangen and Koch,[6] Davis[7] and others). In most cases of weak divergence insufficiency the disorder is functional. The more pronounced paralyses of divergence have been due to a variety of organic diseases of the brain: encephalitis, syphilis, diphtheria, poliomyelitis, chorea, tabes, lead poisoning, hemorrhage, vascular diseases of the brain stem, migraine, multiple sclerosis and cerebral tumor.

1. Duke-Elder, W. S.: Text-Book of Ophthalmology, St. Louis, C. V. Mosby Company, 1933, vol. 1.

2. Riley, H. A.: The Central Nervous System Control of the Ocular Movements and the Disturbances of This Mechanism, Arch. Ophth. **4**:640 (Nov.); 885 (Dec.) 1930.

3. Bielschowsky, A.: Lectures on Motor Anomalies of Eyes: Paralyses of Conjugate Movements of Eyes, Arch. Ophth. **13**:569 (April) 1935.

4. Bruce, G. M.: Ocular Divergence: Its Physiology and Pathology, Arch. Ophth. **13**:639 (April) 1935.

5. Haessler, F. H.: The Divergence Impulse, Arch. Ophth. **26**:293 (Aug.) 1941.

6. Prangen, A. DeH., and Koch, F. L. P.: Divergence Insufficiency: A Clinical Study, Tr. Am. Ophth. Soc. **35**:136, 1937.

7. Davis, W. T.: Diagnosis and Treatment of Phorias, Am. J. Ophth. **21**:145, 1938.

Although the existence of a center for divergence has found so many proponents, authentic pathoanatomic evidence of such a center is almost entirely lacking. I have found only 1 case reported with autopsy, that of Bender and Savitsky.[8] In their case paralysis of divergence was the first and only symptom during most of the clinical course, and autopsy revealed a small hemangioma in the central gray matter and the periaqueductal area at the level between the superior and the inferior colliculi. They expressed the opinion that a center for divergence exists in this area. The same authors cited another case (reported by Straub) of paralysis of divergence associated with a tumor in the middle fossa; no other details were given. Holden[9] mentioned briefly, without other information, a case of paralysis of divergence associated with a tumor of the midbrain. Howard[10] reported a case associated with roentgenographic evidence of multiple metastases of carcinoma of the breast to the cranial bones and the sella turcica. Destruction of the center for divergence by a metastatic tumor of the brain was assumed, but no report of autopsy, follow-up observation or further information was furnished.

The report of a case of paralysis of divergence, the clinical observations in which were confirmed by direct inspection during operative exposure is likely to increase knowledge concerning the center for divergence. The patient, whose chief symptoms were headache and paralysis of divergence during most of the clinical course, was under my observation for more than two years.

REPORT OF A CASE

H. N., a college student aged 20, first consulted me on Dec. 4, 1939. His chief complaints were daily bilateral headaches, mostly localized in the occipital area, usually lasting only an hour at a time and first appearing several months before; dizziness when he stooped, and a slight nasal discharge.

Past History.—There was a history of (1) occasional vomiting in the morning, which had previously been diagnosed as a symptom of gastric ulcer; (2) slight nasal obstruction in childhood, diagnosed as an allergic condition, and several attacks of asthma, and (3) injury to the head through a fall from a horse one year prior to the appearance of headache. This accident resulted in concussion of the brain, but there was no fracture of the skull. Six weeks after the accident the attending physician made the diagnosis of constriction of the visual fields, a condition which disappeared in about ten weeks. (4) The patient had worn glasses for several years.

Examination of the Eyes.—The lids, the anterior segment, the media and the fundus of both eyes were normal. The pupils reacted normally to light and in accommodation. Pronounced nystagmus in the extreme lateral direction of gaze could be observed. The movements of both eyeballs were normal. Tests for heterophoria revealed 5 prism diopters of esophoria for distance; 1 prism diopter of hyperphoria in the right eye, and almost complete orthophoria at reading distance. Tests for vergence revealed 2 prism diopters of positive vertical divergence, 2 prism diopters of negative vertical divergence, 1 prism diopter of abduction and 8 prism diopters of adduction.

With a correction of −0.25 D. sph. −0.75 D. cyl., axis 90 for each eye, vision was 20/20 −1 in the right eye and 20/20 in the left eye.

Otorhinoscopic Examination.—The ears were normal. Inspection of the nose showed hypertrophy of all the turbinates, with pale mucous membranes.

Diagnosis and Subsequent Course.—Divergence insufficiency was suspected, and further observation was planned. A diagnosis of mild vasomotor rhinitis was also made.

Owing to the patient's attendance at a college in another town, he was not seen until May 1940. At that time he stated that his nasal symptoms had improved and that the headaches, dizziness and vomiting had disappeared. He now complained of diplopia in all directions of gaze except when he looked straight upward.

Tests for diplopia with the red glass confirmed his statements. There was esotropia of 6 prism diopters, with no change in the angle of squint in lateroversion and infraversion. The convergent deviation disappeared on supraversion. There was no diplopia on his looking straight upward. When he looked to the left and upward the right eye was higher, and when he looked to the right and upward the left eye was higher. The primary and the secondary angles of squint were equal. The horizontal amplitude of fusion was approximately the same as it was in December 1939 (8 prism diopters). The near point of accommodation was 11 cm. The nystagmus was the same as in December 1939. The impression was that of a possible spasm of both inferior oblique muscles. Since the question of spasm of individual ocular muscles is problematic, no definite diagnosis was made. The vertical deviation was not found again in subsequent examinations during the following years.

On June 13, 1940 caloric tests of both labyrinths showed hypersensitivity on stimulation of either side, the left side being slightly more sensitive than the right. The refractive error and the amount of horizontal deviation were the same as in December 1939 (the vertical deviation had disappeared). Prisms base out were prescribed for distance, a correction of −0.75 cyl., axis 90 ⌒ 3 △ base out being worn in each eye. A few days later the patient reported that he was comfortable and had no diplopia when he wore the new glasses.

In August 1940 diplopia appeared again, in spite of his wearing the glasses; the esophoria for distance had increased to 12 prism diopters. The diagnosis of typical paralysis of divergence was now definite.

In September 1940 the paralysis of divergence was unchanged (with no diplopia at reading distance). When a fixated object was slowly moved away from the eye, diplopia appeared at a distance of 1 meter. Tests of fusional amplitude showed further decrease of abductive power but improvement in adduction. Exercises with prisms failed to produce any improvement.

In June 1941 the esophoria for distance had increased to 15 prism diopters. The patient complained of constant headache, constant diplopia and beginning signs of mental involvement ("lack of interest"). Vision, the

8. Bender, M. B., and Savitsky, N.: Paralysis of Divergence, Arch. Ophth. **23**:1046 (May) 1940.

9. Holden, W. A.: The Ocular Manifestations of Epidemic Encephalitis, Arch. Ophth. **50**:101, 1921.

10. Howard, C. P.: Divergence Paralysis, Am. J. Ophth. **14**:736, 1931.

results of refraction and the appearance of the fundi were unchanged. The impression at this time was that of an organic lesion of the central nervous system, and neurologic consultation was advised. The patient did not submit to a complete neurologic examination until January 1942, when he was admitted to John Sealy Hospital of the University of Texas Medical School, Galveston, Texas. Dr. S. R. Snodgrass permitted me to use the hospital records, data from which are submitted.

Hospitalization.—The patient was admitted on Jan. 31, 1942 and discharged on Feb. 21, 1942, with the diagnosis of intracranial tumor. He was admitted a second time on March 1, 1942 and died on March 14, after suboccipital exploration. The diagnosis was cerebellar tumor.

Ophthalmologic Consultation (January 31): The visual fields were normal. There was blurring of the margins of the disks, but no definite elevation. Nystagmus was noted in all directions of gaze.

Neurologic Examination (February 6): Examination revealed ataxia to the right side and to the left, the disturbance being more pronounced on the left side; dyssynergia of the arms (worse on the left side than on the right); increase in the deep reflexes; motor weakness of the left lower part of the face and the left arm, and absence of sensory changes.

Laboratory Data: Laboratory examinations revealed nothing abnormal. The roentgenogram showed enlargement of the sella turcica and thinning of the posterior clinoid processes. There was no evidence of an old fracture. No definite etiologic diagnosis could be made, but exaggeration of the digital markings indicated increased intracranial pressure. The lesion was thought to be intramedullary or cerebellar. (A cerebral location was also considered.)

The patient left the hospital unimproved. On the second admission, the predominant symptoms were headaches, stiffness of the neck and staggering gait.

Operative Record (March 12).—Dr. Snodgrass made a suboccipital exploration, with partial removal of a cerebellar tumor. Great difficulty was encountered during the first part of the anesthesia, the respiratory rate falling to 4 per minute; operation could be started only after one hour, during which complications were combated. The usual cerebellar incision was made; ventricular pressure was observed to be increased, and clear spinal fluid was withdrawn through a needle until the pressure was normal. The bone over each cerebellar hemisphere was widely removed. The dura was opened first over one hemisphere, then over the other and then laterally across the midline, after division of the occipital sinus between silk sutures. A large tumor, apparently arising in the vermis, filled the cisterna magna almost completely and extended downward. "This tumor was smooth, pinkish brown and firm." A portion of the atlas was then removed and the dura opened down to the second cervical lamina. "The same tumor extended downward to a point completely out of sight. It entirely hid the posterior surface of the cord, as well as the medulla." Frozen sections made during operation were reported as revealing astrocytoma. The lower part of the tumor, measuring 1.5 by 1.5 cm., was withdrawn from the spinal canal without particular difficulty. Slight adhesions to the medulla were noted. The upper end of the tumor (main part) was bluntly dissected from the cerebellum. "It appeared definitely to originate in the vermis." Additional large portions of the central solid portion were then removed by sharp dissection. Obstruction of flow of the cerebrospinal fluid from the ventricles was apparently relieved by the operation. Irregularity in the pulse and adhesions to the medulla made complete removal of the tumor inadvisable. The wound was closed, and transfusions and infusions of dextrose were given.

Pathologic Report (Dr. Paul Brindley; March 20, 1942).—The specimen consisted of seven pieces of tissue, the largest measuring 8 by 6 by 5 mm. and the smallest 2 by 1 mm.

Microscopic Examination: A moderate amount of hemorrhage was noted in a few sections and a rather notable increase of vascularity in all. The blood vessels were all congested. The number of cells was increased in many places, these cells being small, round and dark staining, while in other places the cells were larger and had a somewhat vesicular nucleus. Glial tissue was increased throughout the sections, particularly in the areas where the cells were large and had vesicular nuclei. Some sections showed many small oval calcified bodies. The cells were not pleomorphic. They were all of the one or two types described. In a few places the large cells had a whorl-like arrangement, but this was not uniform. Stains for reticulum and the trichrome stains did not define the nature of the growth any more clearly.

Diagnosis.—The appearance of this tumor was not typical of medulloblastoma, ependymoma or hemangioblastoma, which, with astrocytoma, constitute the cerebellar tumors. Owing to the endothelial proliferation of blood vessels and the conspicuous vascularity, it was impossible to call the tumor an astrocytoma. Special stains did not aid in a more definite diagnosis.

Outcome.—The patient did not respond well to the serious operative procedure and died without regaining much cortical faculty.

COMMENT

Knowledge of the mechanism and the subcortical center for divergence of the eyes in man is incomplete. A review of the literature reveals that the majority of authors have assumed the existence of a center for divergence which is probably located in the metencephalon, in the vicinity of the nucleus of the abducens nerve. Pathoanatomic proof is almost entirely lacking. Only 1 case of paralysis of divergence with autopsy was found; in this instance the authors claimed a center for divergence in the mesencephalon (not far from the nucleus of the oculomotor nerve).

In the case described here paralysis of divergence was the chief symptom during most of the clinical course. Direct inspection during operative exposure proved that the lesion in this case was a tumor of the vermis, extending downward along the medulla. Pressure from the tumor impeded the flow of the cerebrospinal fluid. It is most likely that pressure by the tumor on the subcortical center for divergence caused the paralysis of divergence. A tumor of the vermis of the cerebellum could exert pressure only on the metencephalon. This case, therefore, supports the theory of a center for divergence in the vicinity of the nucleus of the sixth cranial nerve.

FURTHER EXPERIENCES WITH A SYSTEM OF INTRACAPSULAR EXTRACTION OF CATARACT

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The development of a system in any endeavor is worth while. It means an orderly marshaling of one's thoughts and ideas on the subject in hand. This is particularly applicable to the matter of cataract extraction because of the many variables, contingencies and complications which may arise. The surgeon may well review these various situations and his methods of meeting them. I was trained in extracapsular cataract surgery and practiced it for ten years. Now I have had an equal period of experience with the intracapsular method, having adopted it after achieving satisfactory results in selected cases. I have published an article dealing with original variations from published technics and incorporating a new method to be used in coping with difficulties. I became aware that the descriptions of intracapsular technics in the literature did not take into account the observations which should be made before and after each manipulation of the operation and what should be done in case the particular maneuver advocated did not succeed in accomplishing its intended purpose or a complication arose during the maneuver. I have assembled a series of technics, some from the experience of various surgeons, as recorded in the literature, and others which I have devised myself, and have arranged them in a system in which my desire is to fit the maneuver to conditions present and to situations as they arise in the course of the operation. To make the system complete, I have also given attention to the matter of subluxated and luxated lenses. In this paper I shall review briefly the technics as applied to cataracts with intact zonules and the results in 100 consecutive cases occurring within the past two and one-half years in which the intracapsular technic was applied.

The literature has previously been reviewed and contributions, particularly those of Knapp and Verhoeff, acknowledged. The indications for operation, and examination of the patient, the sedation, the induction of anesthesia and akinesia and the postoperative management have beeen described elsewhere.

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THE CAPSULE AND ZONULE

The principal variables for consideration are the conditions of the capsule and the zonule of the lens. Undoubtedly there exists as a cause or as an accompaniment of the development of cataract a degree of degeneration of the capsule and of the zonule. I have never attempted the removal of the normal living, healthy human lens, but I have plans for testing the resistance of the capsule and zonule in eyes from which the normal anterior segment has been removed, for example, because of melanosarcoma. I tested these features in the eyes of a healthy 10 year old monkey and found resistance and resilience much greater than I have ever encountered in the human lens with cataract.

Types of Zonules.—The zonules in cases of cataract may be classified roughly into three types: (1) fragile zonules, which rupture easily, permitting removal of the cataract by traction or pressure alone, approximately 15 per cent; (2) zonules with average resistance, which require pressure plus traction and rotation, both clockwise and counterclockwise, for delivery, 70 per cent, and (3) zonules with more than average resistance, extraction being accomplished by pressure, traction and rotation and, in addition, stripping of the zonule from the upper third of the equator of the lens, 15 per cent.

It will be well again to describe briefly the three efforts and certain other details of the procedure as applied to the various types of cataract, so that the results may be better understood.

OPERATIVE PROCEDURE

Incision and Appositional Sutures Inserted After Incision.—The incision is made in the limbus for one-third the length of the circumference, and it may be enlarged to one-half or two-fifths. It is purposely placed slightly forward to avoid the bleeding encountered with a deeper incision. If the conjunctival flap is wider than 1 mm., the incisions are made radial to the edge of the cornea at 10:30, at 12 and 1:30 o'clock, to permit the better placement of the appositional sutures at these points in the dense corneoscleral tissue. The central suture is used

to retract or to elevate the corneal flap in order that a direct, clear view of the iris and the capsule of the lens may be afforded during the iridectomy and the application of the forceps to the lens capsule. This maneuver is conservative and facilitates operation. It permits of manipulations not otherwise possible. It does not appear in itself to lead to any complications, such as striped keratitis, bullous keratitis, corneal opacity or loss of vitreous, as judged by the experience and the results obtained during the past six years. It is of aid in preventing injury of the endothelium by instruments. One may lift the flap after the delivery of the cataract to view the position of the iris. If the iris is not incarcerated, the use of the iris repositor is avoided. The lifting of the corneal flap can be definitely recommended.

Handling of the Iris.—Retention of the round pupil with peripheral iridotomy is desirable and may be attempted if the pupil will dilate to 6 mm. or more. If it will dilate to 5 mm., retention should be attempted only for small cataracts. If the iris will dilate only to 4 mm., complete iridectomy is necessary. Complete iridectomy is desirable in difficult cases or in cases in which a proper grasp of the peripheral part of the capsule, near the equatorial region, is not feasible. The iris may be retracted with the forceps or with a blunt, flat hook to expose the periphery. A miotic is used after the successful intracapsular operation, even when a complete iridectomy has been performed.

The Three Efforts as Applied to the Three Classes of Zonules.—Effort 1: Preliminary Pressure: Pressure is exerted with the flattened point of the lens expression hook. The points of application of pressure are inside the corneal ring, or limbus, at 4, 6 and 8 o'clock on the corneal dial. Application of pressure may be repeated once or twice. The degree of pressure is such that the cornea is indented 2 or 3 mm. A contraindication to exertion of pressure on the cornea is increased intravitreous pressure. One effect of the pressure may be subluxation of the lens through rupture of the lower portion of the zonule in cases of cataract with a fragile zonule, resulting in relaxation of the capsule. If subluxation does not occur, the maneuver has not been useless, for the surgeon has been able to make observations on the resistance of the eye and the size and consistency of the cataract and to prepare himself for the manipulations necessary for removal of the particular cataract. After the preliminary pressure, if the cataract is subluxated below and is "tumbling," it may be removed by pressure alone. If the lens is subluxated and shows no tendency to "tumble," traction may be applied for delivery. If the lens is not subluxated, it may be delivered by traction, pressure and rotation (effort 2) or, finally, by stripping of the resistant zonule (effort 3).

Effort 2: Traction, Pressure and Rotation: Traction, pressure and rotation, both clockwise and counterclockwise, are applicable to cases of cataract with zonules of average resistance. The forceps are applied above to the anterior face of the equatorial region. 1. Traction is exerted at 12 o'clock and pressure applied directly opposite, at 6 o'clock. 2. The forceps are rotated clockwise at 2 o'clock and then held still, while pressure is applied directly opposite, at 8 o'clock. 3. The forceps are rotated counterclockwise to 10 o'clock and then held still, while pressure is made directly opposite, at 4 o'clock. Indications of rupture of the zonule are watched for. The entire process may be repeated once, and possibly a second time. When subluxation has occurred, complete luxation and delivery may be effected by use of various parts of these manipulations, according to indications. The final extraction is made by sliding or wheeling out the cataract.

Effort 3: Stripping of the Zonule: This procedure is resorted to in cases of an elastic, resistant zonule, recognized as a membrane reenforced by fibers. The capsule must be grasped at or near the upper equator of the lens in order to tilt and lift the latter 3 mm. above the hyaloid membrane. The hyaloid membrane normally does not appear to adhere to the posterior capsule. Before the surgeon resorts to stripping off the zonule, the manipulations of traction, pressure and rotation must be given a full trial, within the limits of safety. A recent, and the only, experience with loss of vitreous in relation to stripping of the zonule was enough to impress this. It is necessary before one strips the zonule to make sure that the capsule is grasped above and near the equator, so that the lens may be tilted and the edge lifted away from the hyaloid membrane. Stripping of the zonule is accomplished by three steps: 1. Touching of the zonular membrane, which has been made tense by traction of the forceps on the capsule at 12 o'clock on the corneal dial. A dehiscence or hole in the zonular membrane may be seen to form. 2. Rotation of the forceps and lens clockwise to 2 o'clock, with stripping between 12 and 10 o'clock. 3. Rotation of the forceps and lens counterclockwise to 10 o'clock, with stripping between 12 and 2 o'clock. Tearing of the zonule and enlargement of the opening may be observed when the lens is rotated clockwise and counterclockwise. Further tearing occurs on rotation with pressure applied directly opposite the point

of traction. After the area of the zonule between 10 and 2 o'clock, representing 120 degrees, has been stripped, complete luxation and delivery are accomplished by traction, pressure and rotation, the lens finally being slid or wheeled out.

Combinations of Maneuvers.—These maneuvers are not described for the purpose of establishing any of them as effective in cases of all kinds. They are of value only when combined in a system which may be varied to suit the individual situation as it arises in the particular case.

Reason for Exertion of Pressure Opposite the Point of Traction.—Observations on the behavior of the capsule under traction show the creation of a principal fold about 2 mm. wide, running from the point of traction to a point in the zonule directly opposite. Pressure is exerted at a point just inside the ring of the limbus of the cornea, where the zonule joins the capsule, in case the former is intact. It stands to reason that pressure over the fold of zonule which is tense will be more effective in rupturing it if applied at a point (approximately the 2 mm. area of the lens expressor hook) rather than over a larger surface. It is also reasonable that the pressure should be applied to the tense fold, and not to the relaxed area of the zonule on either side of the fold, and such pressure is certainly much more effective than any applied outside the ring of the corneal limbus. The same reasons apply to stripping of the zonule in the area made tense by traction in the opposite direction.

Nonrepetition of an Ineffective Maneuver.—The rationale of a system of intracapsular cataract extraction is the development of a series of observations, opinions and maneuvers by which the surgeon has some maneuver in reserve in case the procedure which he had planned or employed fails of its object. It need not be said, however, that he will routinely use any one procedure or apply it unless it carries a reasonable expectancy of success. A maneuver which has been applied once and has failed to accomplish its purpose is not repeated.

RESULTS AND OBSERVATIONS

After this brief description of the methods as they are applied in cases of cataract with intact zonules, a series of cases in which the various maneuvers were employed as indicated may be reviewed with profit. No case was omitted because it was complicated or because the capsule ruptured. One hundred consecutive cases occurring since my original paper was prepared, in 1941, in which the attempt was made to remove the lens in capsule are analyzed.

Capsule.—In 90 cases the cataract was removed in capsule without rupture. In 1 case the capsule ruptured, but the capsule was removed in its entirety after delivery of the nucleus. In 9 cases the capsule ruptured and the operation was concluded with the extracapsular technic.

Zonule.—Fragile zonules were encountered in about 15 per cent of the series; zonules with average resistance, in about 70 per cent, and zonules with above the average resistance, in about 15 per cent.

Types of Cataract.—The following types of cataract were encountered: immature senile cortical cataract, 25 cases; intumescent senile cortical cataract, 1 case; mature senile cortical cataract, 22 cases; hypermature senile cortical (shrunken) cataract, 1 case; nuclear cataract, 27 cases, and posterior cortical cataract, 24 cases.

Age Incidence.—The age distribution is indicated in the following tabulation:

Cases	*Age Period, Yr.*
0	20 to 30
2	30 to 40
7	40 to 50
12	50 to 60
54	60 to 70
21	70 to 80
4	80 to 90

Complications.—In 13 cases cataract was complicated by such conditions as preexisting glaucoma and uveitis.

Sex Distribution.—Of the patients, 43 were males and 57 females.

Number of Operations Performed.—A total of 111 operations was performed to achieve the results in these 100 cases. The following procedures were carried out: preliminary iridectomy, 1 case; preliminary operation for glaucoma, 3 cases; extraction with complete iridectomy, 38 cases; extraction with peripheral iridotomy, 62 cases; excision of prolapsed iris, 2 cases; discission, 2 cases; enucleation (glaucoma), 1 case; paracentesis, 1 case, and reattachment of the retina, 1 case.

Iridectomy and Iridotomy.—In 38 cases complete iridectomy was performed. In 3 of these cases an anterior synechia developed. In 3 cases the pillars of the iris were incarcerated, and in 32 cases the pillars were entirely free. In 62 cases an attempt was made to retain the round pupil by doing only a peripheral iridotomy before the cataract was removed. In 6 of these 62 cases a complete iridectomy was necessary before removal of the cataract. In 4 cases there was a small anterior synechia, and in 2 cases incarceration of the iris resulted. In 52 of the 62 cases

Case No.	Patient's Initials	Age, Yr.	Date of Operation	Resulting Visual Acuity	Refraction
1*	C. P.	70	5/14/40	20/30	+ 9.75 D. sph. ◯ +2.00 D. cyl., axis 82
2	G. D.	64	9/10/40	20/25	+11.25 D. sph. ◯ +2.00 D. cyl., axis 30
3	J. C.	69	10/22/40	20/20	+10.50 D. sph. ◯ +1.25 D. cyl., axis 180
4	F. J.	78	11/12/40	20/30	+11.00 D. sph. ◯ +1.50 D. cyl., axis 135
5	K. F.	73	11/12/40	20/25	+ 9.75 D. sph. ◯ +0.75 D. cyl., axis 120
6	M. L.	74	11/26/40	20/100	+12.00 D. sph.
7	A. W.	75	1/ 7/41	20/20	+10.00 D. sph.
8	H. F.	66	1/14/41	20/20	+ 5.75 D. sph. ◯ +1.00 D. cyl., axis 45
9	S. C.	73	1/14/41	20/30	+14.50 D. sph. ◯ +2.00 D. cyl., axis 60
10	L. S.	62	1/21/41	20/25	+10.00 D. sph. ◯ +2.25 D. cyl., axis 155
11	C. H.	71	2/ 3/41	20/30	+12.00 D. sph. ◯ +1.00 D. cyl., axis 35
12	C. L.	45	2/ 4/41	20/30	+10.00 D. sph. ◯ +1.25 D. cyl., axis 135
13	M. F.	81	2/18/41	20/40	+ 4.00 D. sph. ◯ +3.00 D. cyl., axis 5
14	G. D.	65	4/22/41	20/20	+11.75 D. sph. ◯ +3.00 D. cyl., axis 180
15	F. E.	65	4/22/41	20/20	+11.00 D. sph. ◯ +0.50 D. cyl., axis 20
16	S. L.	65	4/29/41	20/25	+10.00 D. sph. ◯ +0.50 D. cyl., axis 90
17	L. S.	64	4/29/41	20/20	+11.50 D. sph. ◯ +0.75 D. cyl., axis 45
18	M. F.	81	4/29/41	20/50	+ 5.00 D. sph. ◯ +3.00 D. cyl., axis 137
19	F. W.	64	5/ 6/41	20/30	+10.00 D. sph. ◯ +1.00 D. cyl., axis 45
20	S. M.	44	5/ 6/41	20/20	+11.50 D. sph.
21	F. L.	61	5/13/41	H. M.†	+14.00 D. sph.
22	C. H.	71	5/13/41	20/20	+11.50 D. sph. ◯ +2.00 D. cyl., axis 175
23	P. M.	68	5/20/41	20/40	+ 1.50 D. sph. ◯ +4.50 D. cyl., axis 165
24	K. K.	57	5/20/41	20/50	+16.00 D. sph. ◯ +1.25 D. cyl., axis 5
25	H. B.	68	6/ 3/41	20/20	+11.00 D. sph. ◯ +2.00 D. cyl., axis 150
26	J. S.	52	8/19/41	20/20	+12.00 D. sph.
27	C. D.	65	9/ 7/41	20/20+	+12.00 D. sph. ◯ +0.75 D. cyl., axis 135
28	R. I.	43	9/16/41	20/20	+13.25 D. sph. ◯ +0.75 D. cyl., axis 25
29	M. H.	61	9/23/41	20/50	+10.25 D. sph. ◯ +1.25 D. cyl., axis 180
30	S. L.	66	9/30/41	20/20	+11.50 D. sph. ◯ +1.00 D. cyl., axis 90
31	S. E.	64	10/ 8/41	20/25+	+13.00 D. sph. ◯ +1.50 D. cyl., axis 20
32	L. S.	75	10/28/41	20/20	+12.00 D. sph.
33	H. F.	66	10/28/41	20/30—	+ 5.75 D. sph. ◯ +1.50 D. cyl., axis 180
34	E. F.	64	10/28/41	20/30	+12.00 D. sph.
35	S. E.	41	10/28/41	20/20	+14.50 D. sph. ◯ +0.50 D. cyl., axis 25
36	K. F.	73	11/11/41	20/25	+10.00 D. sph. ◯ +1.75 D. cyl., axis 15
37	R. C.	67	11/11/41	20/25	+12.50 D. sph. ◯ +0.75 D. cyl., axis 10
38	M. McE.	65	11/25/41	20/20	+ 6.00 D. sph. ◯ +1.25 D. cyl., axis 180
39	S. E.	64	12/ 9/41	20/30	+ 2.00 D. sph. ◯ +1.75 D. cyl., axis 175
40	S. M.	62	12/16/41	20/25	+13.00 D. sph. ◯ +1.50 D. cyl., axis 20
41	C. F.	46	1/ 7/42	20/20	+11.50 D. sph. ◯ +1.50 D. cyl., axis 15
42	J. M.	68	1/13/42	20/20	+12.00 D. sph. ◯ +1.00 D. cyl., axis 180
43	M. C.	67	1/20/42	20/30	+12.00 D. sph. ◯ +1.25 D. cyl., axis 75
44	D. S.	76	3/ 3/42	20/50—	+ 6.50 D. sph.
45	E. L.	54	1/27/42	20/100 (later light perception only)	+ 8.00 D. sph.
46	M. McE.	66	3/ 3/42	20/20	+ 4.50 D. sph. ◯ +2.00 D. cyl., axis 20
47	L. H.	78	3/ 3/42	20/20	+ 6.50 D. sph. ◯ +1.75 D. cyl., axis 140
48	D. M.	61	3/10/42	20/20	+11.00 D. sph. ◯ +2.25 D. cyl., axis 5
49	A. W.	75	3/10/42	20/20	+11.00 D. sph. ◯ +1.50 D. cyl., axis 10
50	O. M.	38	3/17/42	20/25	+12.00 D. sph.
51	L. S.	62	3/31/42	20/20	+10.25 D. sph. ◯ +2.50 D. cyl., axis 15
52	K. K.	55	4/ 7/42	20/20+	+11.00 D. sph. ◯ +1.50 D. cyl., axis 70
53	H. T.	62	4/ 7/42	L. P.	+ 9.00 D. sph.
54	M. E.	80	4/ 7/42	6/200	+11.00 D. sph.
55	R. F.	51	4/14/42	20/20	+11.00 D. sph. ◯ +2.00 D. cyl., axis 155
56	K. F.	74	4/14/42	20/25	+10.00 D. sph. ◯ +3.75 D. cyl., axis 170
57	M. T.	75	4/28/42	20/30	+ 6.00 D. sph.
58	H. M.	63	4/28/42	20/20	+12.00 D. sph. ◯ +1.50 D. cyl., axis 165
59	L. H.	62	5/12/42	20/30	+11.00 D. sph. ◯ +3.50 D. cyl., axis 175
60	S. M.	45	5/12/42	20/20	+11.50 D. sph. ◯ +1.00 D. cyl., axis 155
61	M. C.	67	5/12/42	20/25	+12.25 D. sph. ◯ +1.50 D. cyl., axis 50
62	G. M.	53	5/12/42	20/200	—8.00 D. cyl., axis 95
63	L. H.	61	5/21/42	20/20	+14.00 D. sph. ◯ +0.25 D. cyl., axis 30
64	E. L.	64	5/21/42	20/20	+12.00 D. sph. ◯ +1.75 D. cyl., axis 172
65	O. M.	38	5/30/42	20/25	+12.00 D. sph.
66	S. M.	61	5/27/42	20/25+	+13.00 D. sph. ◯ +1.00 D. cyl., axis 175
67	E. C.	61	6/16/42	20/20	+11.00 D. sph. ◯ +2.00 D. cyl., axis 25
68	S. W.	66	6/23/42	20/20+	+11.50 D. sph. ◯ +0.50 D. cyl., axis 40
69	W. K.	69	8/11/42	20/20+	+11.00 D. sph. ◯ +0.50 D. cyl., axis 120
70	F. A.	76	8/11/42	20/20—	+11.00 D. sph. ◯ +2.00 D. cyl., axis 35
71	B. L.	62	8/11/42	20/20—	+10.50 D. sph. ◯ +2.00 D. cyl., axis 30

* It was found after the paper had been written that in another case, with many complications before operation, the operation had been performed during the period. If this case were included, it would have taken the place of case 1, also a complicated one, and would not have materially altered the record.

† H. M. indicates ability to detect hand movements.

Statistical Survey—Continued

Case No.	Patient's Initials	Age, Yr.	Date of Operation	Resulting Visual Acuity	Refraction
72	F. M.	69	8/11/42	20/20	+12.00 D. sph. ⊂ +1.00 D. cyl., axis 25
73	M. C.	74	8/18/42	20/20	+ 9.00 D. sph. ⊂ +2.00 D. cyl., axis 175
74	L. S.	63	8/18/42	20/20	+10.25 D. sph. ⊂ +2.50 D. cyl., axis 15
75	B. G.	58	8/29/42	20/20	+14.00 D. sph. ⊂ +0.50 D. cyl., axis 85
76	A. D.	74	9/15/42	20/30	+11.50 D. sph. ⊂ +3.00 D. cyl., axis 90
77	S. G.	72	9/15/42	20/30	+10.00 D. sph.
78	E. C.	61	9/18/42	20/20	+10.50 D. sph. ⊂ +3.00 D. cyl., axis 140
79	B. J.	75	9/22/42	20/20	+11.00 D. sph. ⊂ +1.25 D. cyl., axis 50
80	J. S.	71	9/22/42	20/20	+11.00 D. sph.
81	G. M.	53	9/22/42	20/50	+ 0.50 D. sph. ⊂ −6.00 D. cyl., axis 100
82	P. F.	66	10/13/42	20/20—	+10.75 D. sph. ⊂ +1.00 D. cyl., axis 15
83	F. S.	51	10/13/42	20/20	+10.50 D. sph. ⊂ +1.00 D. cyl., axis 170
84	E. O'H.	67	10/13/42	20/20	+11.00 D. sph. ⊂ +1.00 D. cyl., axis 30
85	A. M.	60	10/13/42	20/30	+ 8.00 D. sph. ⊂ +4.00 D. cyl., axis 172
86	P. D.	57	10/20/42	20/25	+10.00 D. sph. ⊂ +1.50 D. cyl., axis 42
87	E. L.	64	10/20/42	20/20	+12.00 D. sph. ⊂ +1.25 D. cyl., axis 160
88	F. M.	69	10/20/42	20/20	+12.00 D. sph. ⊂ +1.00 D. cyl., axis 180
89	E. D.	69	10/20/42	20/20—	+11.50 D. sph.
90	M. L.	66	10/20/42	20/25	+10.75 D. sph. ⊂ +2.00 D. cyl., axis 45
91	F. H.	64	11/10/42	20/20	+ 8.00 D. sph. ⊂ +4.50 D. cyl., axis 10
92	C. H.	66	11/10/42	20/20	+ 8.00 D. sph. ⊂ +1.50 D. cyl., axis 15
93	S. L.	66	11/10/42	20/25	+10.50 D. sph.
94	E. G.	83	11/17/42	20/25	+10.50 D. sph. ⊂ +3.00 D. cyl., axis 20
95	S. F.	67	11/17/42	20/25	+ 4.00 D. sph. ⊂ +3.00 D. cyl., axis 165
96	E. O.	68	11/17/42	20/100	+10.00 D. sph.
97	E. C.	41	11/24/42	20/20	+ 6.50 D. sph. ⊂ +1.50 D. cyl., axis 45
98	H. N.	62	12/ 1/42	20/20	+13.00 D. sph. ⊂ +0.50 D. cyl., axis 160
99	D. C.	55	1/ 5/43	20/25	+ 3.50 D. sph. ⊂ −1.50 D. cyl., axis 5
100	R. C.	55	1/ 5/43	20/20+	+13.00 D. sph. ⊂ +1.25 D. cyl., axis 15

round, mobile pupils remained, without any synechia.

Loss of Vitreous.—In the 62 cases in which retention of the round pupil was attempted, the vitreous presented, with no loss in 3 cases and with loss in 4 cases. Of the 38 cases in which complete iridectomy was planned, vitreous presented, with no loss in 3 cases and with loss in 2 cases. Of the total series, vitreous presented with no loss in 6 cases and with loss in 6 cases. An analysis of the cases in which vitreous was lost follows.

In case 97 fluid vitreous seeped out directly after the incision had been made; the loss had no relation to the type of operation which followed. Stripping of the zonule was resorted to in this case, even in the face of the loss of fluid vitreous, because it seemed to be the only procedure which was feasible. The result was good. In case 62, because of severe and persistent vomiting due to sensitivity to codeine, prolapse of the iris developed forty-eight hours after the extraction. Loss of vitreous was experienced in the attempt to excise the prolapsed iris. In the same case, without the use of codeine, the other eye was operated on, with no loss of vitreous. In 2 complicated cases of glaucoma, in both of which previous operations had been performed, loss of vitreous occurred—in case 18 when the capsule ruptured and in case 21 during replacement of the iris pillars. In 2 cases (26 and 98) the loss of vitreous occurred unexpectedly during the actual delivery of the cataract in capsule. In both the hyaloid membrane seemed to be pathologically adherent to the posterior capsule of the lens and to follow the lens out in the shape of a cone.

Postoperative Condition of the Vitreous.—In general, pigment granules were enmeshed in the anterior portion of the vitreous and on the surface of the hyaloid membrane. In 28 cases the surface of the vitreous was flat and in its proper place behind the iris; in 45 cases there was a low mound at the border of the iris; in 18 cases the vitreous mushroomed through the pupil, and in 6 cases it was incarcerated. In 2 cases the vitreous formed a small mushroom through a discission opening, and in 1 case, through an iridotomy opening. The round pupil does not protect or hold back the vitreous during the extraction, but after healing has occurred, and when the round pupil is mobile and small, the iris helps to retain the vitreous better than the coloboma formed by the complete iridectomy.

Visual Results in Cases of Loss of Vitreous.—The patient with the fluid vitreous (case 97) had visual acuity of 20/20 with correction, and the patient with the prolapsed iris (case 62) visual acuity of 20/200 with a high minus cylinder. The latter had had considerable myopia before the cataract developed, and there were large areas of degeneration in the choroid and retina. In case 21, with increased intraocular tension complicating uveitis, vision was limited to perception of hand movements. In case 18, with apparent primary glaucoma complicating cataract, result-

ing vision was 20/30. In the other 2 cases (26 and 98), in which the vitreous appeared adherent to the posterior capsule of the lens, vision was 20/20 with correction.

Presentation of Vitreous Without Loss.—In 6 cases the vitreous presented at the time of actual delivery of the lens but none was lost. In 3 of these cases the vitreous receded and the eyes did well. The vitreous appeared mushroomed into the anterior chamber, but there was no inflammation and no increased tension, and the visual result was 20/20 in each case. In case 12 the vitreous became adherent to about one third of the incision, but there was no untoward development. In the other 2 cases (92 and 55) a secondary increase in intraocular tension developed. This was controlled by use of a 1 per cent solution of epinephrine bitartrate and a jelly containing 0.5 per cent epinephrine bitartrate over a period. In case 55 the patient is still under observation for control of the pressure.

Hemorrhage.—In 8 cases severe hypertension, not relieved by rest and medication, was present before and during the operation. In 17 cases there was embarrassing hemorrhage at the time of the operation, while in 8 of these 17 cases secondary hemorrhage occurred after operation. In 2 cases particularly severe hemorrhages were experienced, 1 being case 77, in which the blood was finally absorbed, after one month, with resulting vision of 20/30. In the other case (45) the patient was a particularly poor risk, with obesity, severe hypertension, nephritis and loss of one eye as a result of an injury in World War I. Six months' preparation of this patient was not sufficient to prevent hemorrhage. Vision with correction, five weeks after operation, was 20/100. In the sixth week a series of severe intraocular hemorrhages developed. Increased intraocular tension supervened, and it was necessary later to enucleate the eye.

Inflammation.—In 8 cases (68, 79, 92, 53, 21, 35, 42 and 47) there was evidence of uveitis before operation. Of these, postoperative inflammation developed in 5 cases, while in 3 cases (68, 35 and 47) the eye remained free. In 10 cases uveitis or iridocyclitis which followed operation was controlled with difficulty. Of these, a secondary, or adventitious, membrane formed over the surface of the vitreous, requiring discission, in 1 case (63), while iridotomy was necessary in another (case 1). A cyclitic membrane developed in 2 cases with complications (21 and 53), and vision was not restored. In both these cases severe uveitis and secondary increase in intraocular tension were present before the operation for cataract, and iridectomies had been performed by other surgeons.

Inflammation arose in 6 cases without previous complication—in 3 cases after extracapsular delivery following the attempted intracapsular procedure and in 3 cases after intracapsular delivery. In 1 of the latter cases (26) vitreous had been lost.

In case 1 a recent infection of the respiratory tract had existed, and purulent endophthalmitis developed. The use of sulfadiazine and nonspecific foreign protein resulted in preservation of the eye after secondary rise of tension, iris bombé and iridotomy by transfixion of the iris, with final useful vision of 20/30.

Glaucoma.—In 2 cases (13 and 18) primary glaucoma, and in 2 cases (21 and 52) severe uveitis with increased intraocular tension, complicated cataract before operation. In the first 2 cases a preliminary operation was performed, and final vision was 20/50 and 20/30 respectively, while in the last 2 cases only light perception remained.

Of 6 cases in which there was no evidence of glaucoma before operation, the intraocular tension rose in 3 (cases 1, 92 and 55) after the intracapsular operation, and in 2 cases the increase in tension was temporary and was controlled by medication, after which no treatment was necessary. In 1 case (1) iridotomy by transfixion of the iris gave satisfactory results. Of the 3 cases of extracapsular extraction after attempted intracapsular delivery, repeated paracentesis satisfactorily relieved the condition in case 38, sclerectomy and peripheral iridectomy were necessary in case 2 and enucleation was finally required in case 45.

Behavior of the Patient During and After Operation.—Sedation, local anesthesia and induction of akinesia were employed in all cases of the series. In 18 cases the behavior of the patient at the time of operation was embarrassing, through lack of cooperation, inability to maintain a satisfactory position of the eyes, coughing, movement of the head, rigidity, inability to relax or other nervous manifestations. In at least 6 of these cases induction of general anesthesia would have been dangerous because of hypertension and insufficient cardiac reserve. In 6 cases an irrational condition developed after the operation, in 1 (case 77) of which a serious hemorrhage and prolapse of the iris resulted.

Detachment of the Choroid.—In no case was ophthalmoscopic inspection of the fundus made directly after removal of the cataract. In the early period of convalescence, the anterior segment was carefully inspected with the aid of an

oblique pencil of light from a self-luminous flashlight. Only toward the end of the twelve day period of hospitalization was ophthalmoscopic examination made. Detachment of the choroid was found at this time in 5 cases, in which it was associated with the following conditions: in case 5, with continued leakage from the incision, the central suture of which had loosened, with resuture on the tenth postoperative day; in case 92, with delayed reformation of the anterior chamber, anterior synechia and secondary increase of intraocular tension, which developed later; in case 24, with chondrodystrophia, in which the sclera was particularly rigid and the retina became detached later, with complete reattachment after operation (to be described in the next section); in case 18, with glaucoma, rupture of the capsule and slight loss of vitreous, and in case 26, with loss of vitreous. In each of these 5 cases the choroid became reattached completely after varying periods, the longest (case 24) being five months.

Detachment of the Retina.—In case 24 detachment of the retina developed. This case was a particularly interesting instance of osteochondrodystophy with general maldevelopment, in which detachment of the retina of the right eye followed an extracapsular extraction by a surgeon in a distant city. The patient was referred to me for operation for reattachment of the retina in this eye. The entire lower half of the retina was detached in bullous form. No tear was detected. Extensive surface diathermy was used over the sclera, which proved to be at least 1.5 mm. thick. Penetrating diathermy was also employed, and, finally, two trephine openings were made for drainage. Complete reattachment of the retina was obtained in three months, with a resulting satisfactory visual field and central vision of 20/50 with correction. I removed the cataract from the left eye by intracapsular extraction, with complete iridectomy. Detachment of the choroid developed and was followed later by extensive detachment of the retina. An operation was performed on this eye similar to that described for reattachment of the retina in the right eye. A similar, entirely successful result was obtained. I have operated on a total of 5 aphakic eyes with detached retina, and this is the only case in which I have been successful.

Astigmatism After Operation.—In 15 per cent of the cases no correction was required for astigmatism; in 13 per cent there was no to 1 D. of astigmatism, or 1 D. or less in 28 per cent; in 38 per cent there was 1 to 2 D. of astigmatism, or 2 D. or less in 66 per cent, while in 16 per cent there was 2 to 3 D. of astigmatism, in 9 per cent 3 to 4 D. and in 5 per cent 4 D. or more; in 4 per cent the patient was unable to estimate the astigmatism.

The average strength of sphere accepted was + 10.5 D., and the average strength of cylinder, + 1.50 D.

Resulting Visual Acuity.—In 5 per cent of cases vision was 20/20 + ; in 44 per cent, 20/20, or 20/20 or better in 49 per cent; in 4 per cent, 20/20 —; in 19 per cent, 20/25; in 14 per cent, 20/30, or 20/30 or better in 86 per cent; in 2 per cent, 20/40, or 20/40 or better in 88 per cent; in 5 per cent, 20/50; in 2 per cent, 20/100; in 1 per cent, 20/200, and in 4 per cent, less than 20/200.

Visual Acuity of 20/100 or Less: In case 6, with visual acuity of 20/100, and in case 54, with an acuity of 12/100, central chorioretinopathy was due to senile degeneration. In 2 cases (21 and 53) in which uveitis and secondary increase of intraocular tension preceded the cataract, vision was limited to perception of hand movements. In case 45, in which vision of 20/100 was obtained five weeks after operation, severe hemorrhagic glaucoma later developed, with unbearable pain and reduction of vision to perception of light. Finally, enucleation was necessary. In the 1 case (62) in which vision was 20/200 degenerative myopic choroioretinopathy existed.

SUMMARY AND CONCLUSIONS

The system of manipulations used in intracapsular extraction of cataract with intact zonule is briefly described again, and the statistics of results in 100 consecutive cases of intracapsular extraction, representing every case in which the operation was attempted, are given. The results substantiate claims for the safety and rationale of the procedures employed. Two years ago it was stated that the manipulations of appositional suturing after the corneal incision, the lifting of the corneal flap and the application of the three efforts (the preliminary pressure; the pressure, traction and rotation, and the stripping of the zonule) were all feasible. Now it is reported that they are conservative and desirable. A series of observations made before and after each maneuver of intracapsular extraction with use of the indicated manipulation is worth while. The effect of each maneuver was studied with respect to the accomplishment of its purpose and the event of any complication resulting from or occurring independent of the maneuver. A maneuver which was ineffective in any particular case was not repeated. A variety of maneuvers is possible from combinations of those which have been described. They have all proved satisfactory in their application to the cases in which

intracapsular extraction was attempted and have been applied even when the zonule was resistant. The future may indicate changes in this system of intracapsular extraction of cataract as applied to lenses with intact zonules, but so far it has been satisfactory.

780 Park Avenue.

DISCUSSION

DR. C. A. CLAPP, Baltimore: Has Dr. Kirby any pathologic specimens showing that the zonular fibers are replaced by a membrane? Certainly, in all my sections of eyes I have never seen such a condition occur. It is quite possible that this condition may be a congenital anomaly; however, I have never encountered it.

DR. JOHN GREEN, St. Louis: In private discussion among members of the society, the point has been raised that elevation of the corneal flap and eversion by means of the central suture might induce keratitis or other permanent changes in the cornea. I have been using this central suture for eversion for the last five years. My experience bears out Dr. Kirby's contention that the maneuver is harmless. I have never observed any corneal complication that could reasonably be ascribed to this procedure.

DR. THOMAS D. ALLEN, Chicago: I did not give much consideration to postoperative peripheral synechiae until I began to use the contact glass routinely in postoperative examination. I did not realize how frequent is the postoperative occurrence of peripheral synechiae, a condition which, it seems to me, predisposes to glaucoma. Has Dr. Kirby used the contact glass in postoperative examinations? How does he make the diagnosis of peripheral synechiae?

DR. DANIEL B. KIRBY, New York: In reply to Dr. Clapp, it is well recognized by such men as Troncoso, Duke-Elder and Goldsmith that in living eyes, and in fresh eyes which have recently been removed from the body, there is a definite membrane which stretches between and over the zonular fibers. I, personally, have no doubt of the existence of such a membrane.

In answer to Dr. Green, I can definitely state that elevation of the flap is a conservative maneuver, and I have never seen any complication due to it alone. I have even lifted the flap after the cataract was removed. That can perhaps be said to be a more hazardous procedure, but it has never resulted in any complication. I observe the position of the iris, and if it is not incarcerated between the lips of the wound, I do not employ the iris repositor, for I know that use of the miotic will draw the iris into the anterior chamber. The precautions used in the prevention of anterior synechiae are (1) avoidance of trauma to the iris and the endothelium of the cornea, (2) rapid closure of the anterior chamber by efficient suturing and (3) drawing of the iris into its proper place by use of a miotic.

I have used the contact glass in the examination of patients after convalescence, but not as a routine measure. I think one can tell by the plane of the iris whether it is near the plane of the incision. I can definitely state that anterior synechiae were present in only 4 per cent of cases in which vitreous was not lost. In 1 case glaucoma developed, but with use of miotics and agents for contraction of the blood vessels, the tension was brought under control. In 5 previously reported cases anterior synechiae accompanied incarceration of vitreous after loss of vitreous.

BOWEN'S DISEASE OF THE CORNEA

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In 1912 Bowen [1] first described in detail a disease of the skin which he called precancerous dermatosis. It is characterized by the presence of lenticular or nummular spots which coalesce to form asymmetric plaques of various sizes. These plaques may be squamous or scabby, papular or wrinkled. Sometimes they regress and assume the appearance of atrophic spots. They may be a shade darker than the skin or may vary from pale pink to dark pink or copper red. Their outline is sharp; there is no halo of congestion. When the scab is removed, a wet, pink surface appears, which may be smooth, granular or, more rarely, warty. But soon new layers cover the area.

The disease is extremely chronic and slowly progressive. Cases in which the disease developed over twenty, thirty or even forty years have been recorded. Histologically, the lesion has the appearance of an epithelioma composed of dyskeratotic cells which have not yet ruptured the basement membrane—"intraepithelial epithelioma". It persists unaltered in this phase for a long time, but at last it becomes a true epithelioma, breaking through the basement membrane, infiltrating the underlying tissues and metastasizing. It is said, however, that in Bowen's disease metastasis may occur before the lesion becomes a true epithelioma.

In 1921 Jessner [2] reported the first case of the lesion observed on a mucous membrane. Since then several cases in which Bowen's disease involved the skin and mucous membranes have been described, and at present this disease is well known to dermatologists.

Before Bowen's report, Darier had described several diseases, such as psorospermosis vegetans, Paget's disease (osteitis deformans) and molluscum contagiosum. Common to all were cells of a certain type, which he called dyskeratotic. Thus was created the group of dyskeratotic diseases. When Bowen described the disease that now bears his name, Darier [3] included it in this group, as dyskeratotic cells were present. Two dyskeratotic diseases, Paget's and Bowen's, evolve into cancer after a considerable period. This peculiarity has given rise to a subgroup, known as precancerous dyskeratosis, or epitheliomatous dyskeratinization. But some authors have maintained that the term "precancerous" is not applicable and have asserted that the lesions are true epitheliomas from the beginning. The fact that the lesion does not break through the basement membrane to infiltrate the underlying tissues simply means that the epithelioma is in a stage of evolution; if sufficient time is given, however, it will assume the infiltrative character of all epitheliomas.[4]

In a review of the ophthalmic literature, I did not find the report of any case of Bowen's disease in which the cornea was involved until 1942. In February 1942 McGavic [5] recorded 5 such cases; a year later Wise [6] referred to another case. Ash and Wilder,[7] in a paper dealing with epithelial tumors of the limbus, mentioned 4 cases in which the structure of the lesion was similar to that of Bowen's dyskeratosis. Thus, only two reports of Bowen's disease of the cornea have been made previously, and the presentation of my case is the third.

In McGavic's cases 4 patients were women, of whom 3 were over 60 and 1 was 46 years of age. The age of the only male patient was not given. Wise's case was that of a man aged 62. In the present case the patient was a man aged 56. One may say that the disease is fairly equally distributed between the sexes (57 per cent women and 43 per cent men), with a slight predominance of women. But in both men and women the disease appears after the forty-fifth year.

With respect to the presumable cause, in 3 of McGavic's cases trauma or inflammatory lesions

Read at the monthly meeting of the Sociedad de Oftalmología del Litoral, in May 1943.

1. Bowen, J. T.: J. Cutan. Dis. **30**:241, 1912.

2. Jessner, M.: Arch. f. Dermat. u. Syph. **134**:361, 1921.

3. Darier, J.: Ann. de dermat. et syph. **5**:449, 1914.

4. Rousset, J.: Les dyskératinisations épithélioma-teuses, Paris, Masson & Cie, 1931.

5. McGavic, J. S.: Am. J. Ophth. **25**:167, 1942.

6. Wise, G.: Am. J. Ophth. **26**:167, 1943.

7. Ash, J. E., and Wilder, H. C.: Tr. Am. Acad. Ophth. (1941) **46**:215, 1942.

of the cornea existed prior to the dyskeratotic changes. In his other 2 cases there had been no previous corneal disturbance. In the case presented by Wise and in that which will be described here no corneal lesion was present before the growth appeared.

normal cornea. The whole lesion had the appearance and the grayish color of ground glass except at the edges, near the limbus, where it was pinkish. On the surface, little globular, translucent excrescences of gelatinous tissue were observed. The pinkish color was given by fine blood vessels arising from the limbus and invading that area of the plaque. They stopped

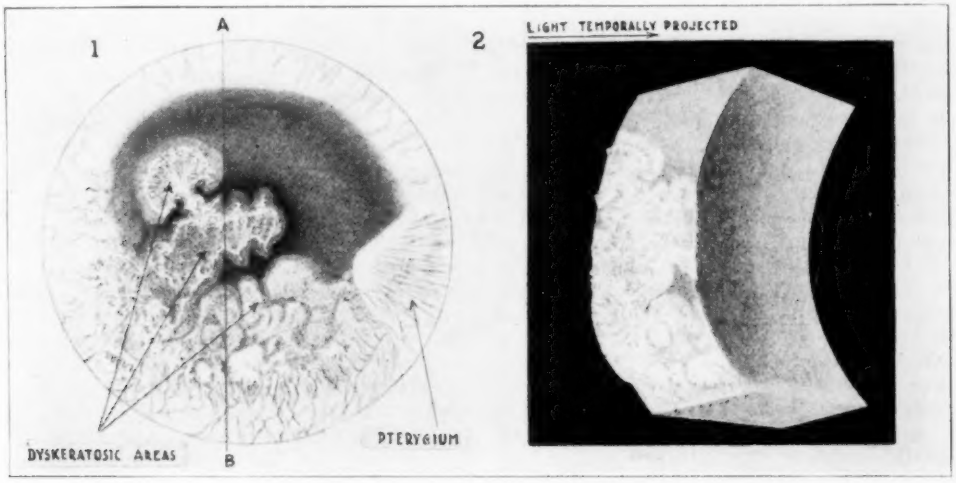

Fig. 1.—(*1*) Drawing of the lesion on the right cornea, *AB* being the axis of a semischematic cut, a photograph of which (*2*) was obtained with the slit lamp.

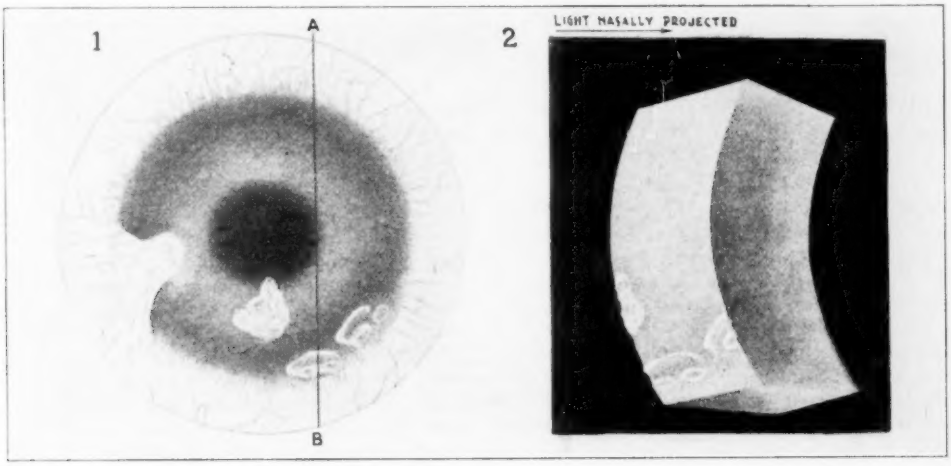

Fig. 2.—(*1*) Appearance of the lesion on the left eye, *AB* being the axis of a semischematic cut, a photograph of which (*2*) was obtained with the slit lamp.

REPORT OF A CASE

On Nov. 20, 1942 a healthy-looking man aged 56 came to my private clinic with a condition of the cornea which had appeared three years before in the right eye and more recently in the left eye.

Gross Appearance.—The cornea of the right eye presented a plaque formed by the coalescence of numerous small, rounded spots. The process was slowly progressive but not ulcerative. It covered the lower half of the cornea and involved the pupillary field almost completely. Subsequently, vision was reduced to ability to count fingers at 3 meters. The plaque had a scalloped edge, which ended abruptly at the shortly after penetrating the plaque 2, 3 or 4 mm., before returning to the limbus. The plaque was vascularized only in the parts lying near the limbus. The vessels were dendritic and ran within the epithelium, without passing into the stroma at any point. The corneal tissues around the plaque were normal, and the limbus surrounding the normal portion of the cornea showed no vascular reaction. Examination with the slit lamp revealed that the lesion was lying in the epithelium, the parenchyma being normal.

A second examination revealed a pterygium at the inner angle of the eye, which advanced a few millimeters onto the cornea (fig. 1). Sensitivity of the cornea was reduced in the pathologic area only.

In the left eye I encountered three plaques on the cornea, formed, like the one previously described, by coalescence of numerous small spots. One of the plaques lay on the vertical meridian, immediately beneath the pupil. The other two were at the periphery, between 4 and 5 o'clock. Perikeratic, as well as intracpithelial, vascularity was almost entirely absent. The whole lesion resembled the plaque in the right eye, the only difference being that it was less vascularized (fig. 2).

According to the patient's statement, light usually did not disturb him much, but he had periodic attacks of photophobia and tearing. He did not complain of spontaneous or of provoked pain.

General Physical Examination.—Nothing significant was observed except for the presence of whitish plaques on the mucous membrane of the lower lip. The patient told me that they had been treated with solid carbon dioxide three or four times, but always reappeared. A specimen from one of these plaques was sent to the pathologist, Dr. Anibal Castañe, of the department of dermatology of the faculty with which I am associated. He reported as follows:

"The epithelium covering the semimucous membrane of the lower lip showed a thick, horny layer and a stratum granulosum formed of five or six layers. The epithelium owed its thickness to the presence of uniform cells. No cells similar to those characteristic of dyskeratosis were present. No atypical mitotic figures or polymorphism was observed. The corpus mucosum of Malpighi and the generative layer showed no important change. The upper part of the corium and the papillary layer of the dermis were sclerosed and invaded by lymphocytes and by vessels, which were congested.

"One may conclude that the semimucous membrane of the lower lip had acquired features similar to those of the skin of the hand or foot; that is, a stratum granulosum and a thick horny layer, which normally do not belong to the lip. Besides, there were sclerosis and lymphocytic infiltration. All these features suggest classification of the lesion as leukoplakia of the lip."

The skin presented no lesion of any kind; it appeared perfectly healthy.

Since the corneal lesion that interfered with vision was confined exclusively to the epithelium, a superficial excision was made. The wound healed in a few days, the cornea being clear and transparent. The excised specimen was fixed in Bouin's solution and embedded in paraffin. Sections were stained by several methods.

Microscopic Study.—Under low magnification, the epithelium appeared of varying thickness. In some places it was many times as thick as normal, twenty or more cells being counted, and in the thinner portions only six or seven cells were seen, a number which was also above the normal. The thicker parts corresponded to the excrescences which were clinically evident on the corneal surface. The epithelium covering the affected area ended abruptly at the normal epithelium. It did not stain uniformly but appeared to be covered with faded blotches. The epithelial cells were not normally arranged in layers but were irregularly intermingled. Only cells bordering on the basement membrane retained their palisade arrangement. Bowman's membrane appeared intact throughout, and the underlying parenchyma was also normal. Some clear, large cells were scattered throughout the epithelium. Several vessels were discernible (fig. 3).

With high magnification the anarchy in the shape and arrangement of the epithelial cells could be appreciated. The cells varied in size to an extraordinary degree: Some were small, while others were many times as large as normal. Some cells stained well and others faintly. They were not in layers but were arranged in disorderly fashion. In several places they were concentrically arranged, with the well known appearance of epithelial pearls. Certain cells presented atypical mitotic figures. Their nuclei assumed various sizes and shapes; some of them were elongated and others rounded or clumped. Some nuclei stained well, while others remained pale.

Certain cells attracted attention because of their paleness and enormous size, which was many times that of the basal cells. They had no tonofibrils. One encountered them among the basal cells, as well as in the middle portion or on the surface of the epithelium. Wherever they lay, they were remarkable for their enormous size and for their peculiar appearance. They occurred alone or in small groups, but they were always connected with their neighboring cells by intercellular bridges, which were clearly demonstrable. The nucleus of these cells was irregular in shape, being rounded, elongated or clumped. It was enormous and contained one, two or three nucleoli. Each nucleus was partially or totally surrounded by a vacuole, which pushed the protoplasm to the periphery. The cytoplasm was finely granular and finely vacuolated. It was condensed at the periphery, so that the cell was sharply outlined. These cells were of the dyskeratotic type.

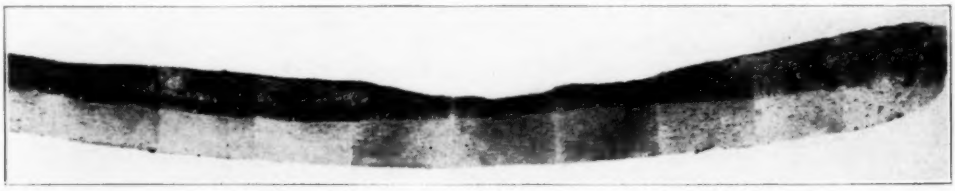

Fig. 3.—Panoramic photomicrograph, taken with low magnification. The epithelium is irregularly thickened. The staining qualities are also irregular, as some areas appear dark and others clear.

The intracpithelial vessels had their own walls. Some of them appeared to be surrounded by an infiltrate of cells and plasmalymphocytes. In several places the perivascular connective tissue had undergone hyaline degeneration. Isolated hyaline "herds," arising perhaps from the perivascular connective tissue, were also noted. The cells around the vessel had the appearance of a papilla in transverse section (figs. 4 and 5 *A*). Bowman's membrane was unruptured; only at certain points was it penetrated by vascular buds. The basal cells, however, did not invade the underlying stroma at any point, but retained their orderly arrangement (fig. 5 *B*). The underlying stroma was normal, but at certain places, immediately beneath the epithelium, slight infiltration with plasma cells and lymphocytes was present (fig. 5 *C*).

The lesions described were confined exclusively to the epithelium of the cornea in the left eye, but in the right eye they also involved the epithelium of the nearest portion of the conjunctiva to a slight extent.

All these changes, that is, the lack of orderly arrangement of the cells, their diversity in size and shape, their monstrosities, the atypical mitotic figures and the variation in staining properties, gave the lesion the appearance of an epithelioma. But two outstanding features marked the difference between this growth and a true epithelioma: First, the basement membrance was not ruptured at any point, all the cellular changes taking

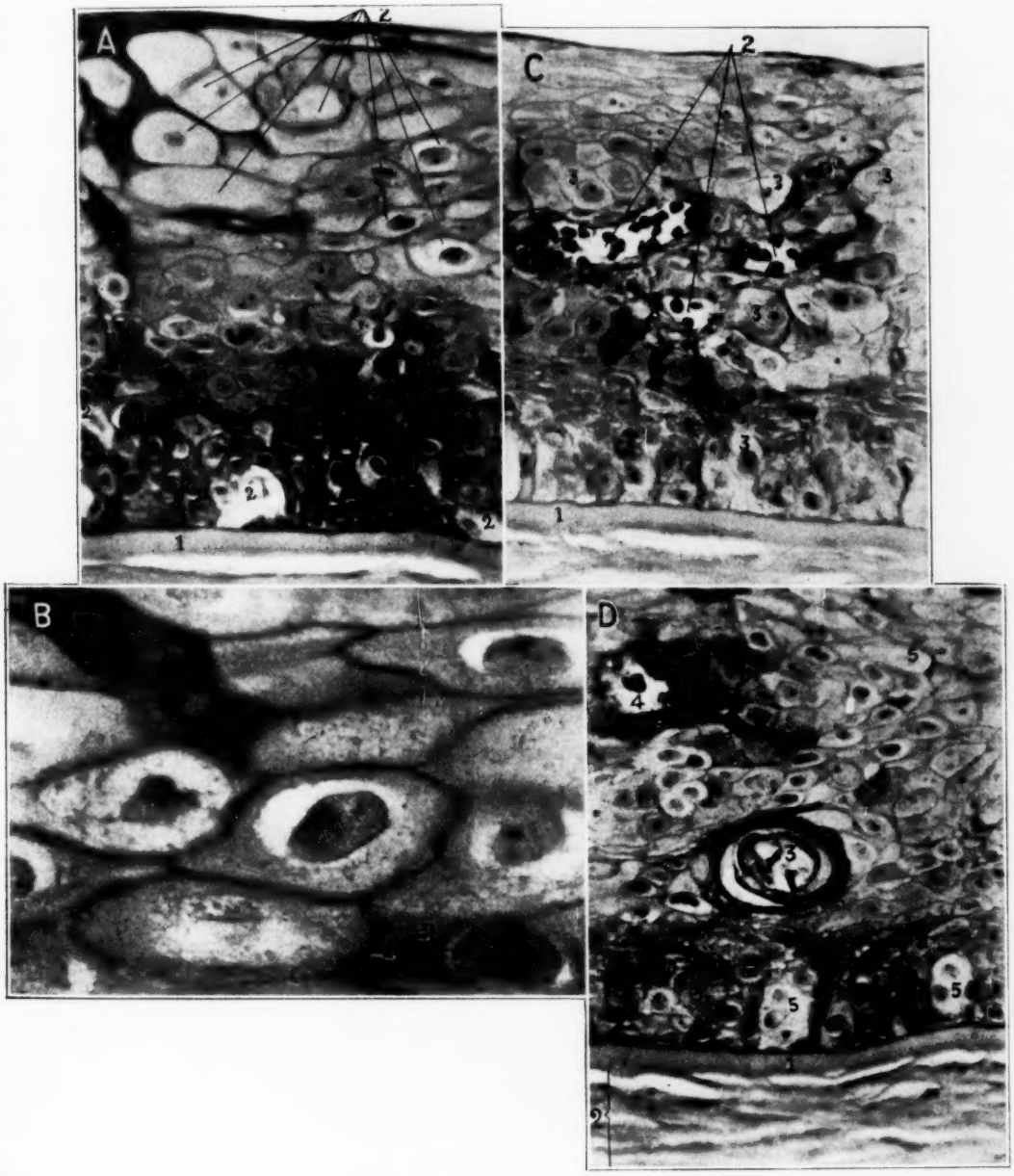

Fig. 4.—*A*, thickening of the epithelium, due to the presence of numerous cells, disorderly arranged and varying in size and staining characteristics. *1* indicates the basement membrane, which is intact, and *2*, monster cells. The cytoplasm is hypochromatic, condensed at the periphery, finely granular and finely vacuolated. Intercellular bridges are clearly seen. The nuclei are large, vary in shape and contain more than one nucleolus. The nuclei are surrounded by a vacuole (dyskeratotic cells of Bowen's type).

B, high magnification of the monster cells shown in *A*, with large nuclei of various shapes, containing nucleoli and surrounded by a vacuole. The protoplasm is granular and vacuolated. Intercellular bridges are discernible.

C, hyperplastic epithelium, made up of cells which show great variation in size and are disorderly arranged. *1* indicates Bowman's membrane, which is normal; *2*, capillary vessels with red corpuscles in their lumens, and *3*, some dyskeratotic cells.

In *D*, *1* indicates Bowman's membrane; *2*, the corneal parenchyma, *3*, an epithelial pearl; *4*, a capillary vessel surrounded by hyaline masses derived from degenerated perivascular connective tissue, and *5*, some dyskeratotic cells.

place within the epithelium, and, second, there were dyskeratotic cells with intercellular bridges. All the histologic changes encountered in the corneal lesion were similar to those observed in lesions of Bowen's disease of the skin.

In my opinion, superficial excision is the treatment of choice when dyskeratosis is suspected.

It is interesting to note that the corneal lesion was the only manifestation of Bowen's disease in this case, the skin being healthy.

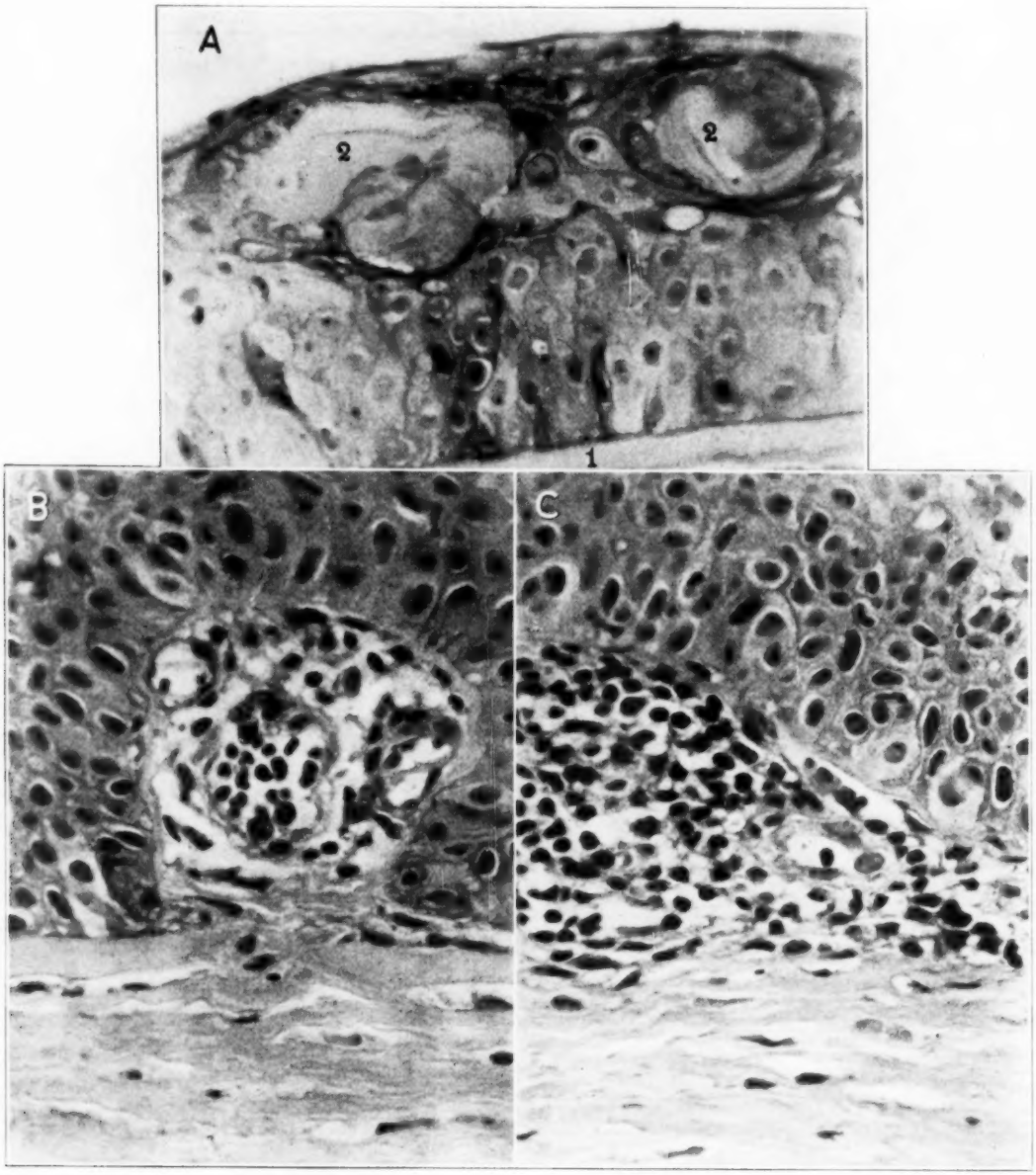

Fig. 5.—*A*, photomicrograph, showing some of the cellular features described in the preceding figure. *1* indicates the basement membrane, which is intact, and *2*, hyaline "herds." *B*, Bowman's membrane penetrated and disrupted by a vessel. The perivascular cells surround the vessel, arranged like a papilla. The basement cells do not invade the stroma. *C*, subepithelial infiltrate. The basement membrane is disrupted, but the epithelium does not invade the underlying tissues.

Again, in the present case, it must be added that although the area of excision involved almost one-half the cornea, the postoperative course was excellent. In a week the wound was healed and the cornea perfectly transparent. When the patient was examined eleven months later, no sign of recurrence was present. Vision was recorded as 2/3 with Snellen's chart.

COMMENT

A diagnosis of Bowen's disease of the cornea can be made only through a histopathologic study of the lesion. The pathologic process involves only the epithelial layers of the cornea. Therefore, when Bowen's disease is suspected,

a specimen for biopsy can be taken without fear of damage to the eye. The following clinical features may lead to a tentative diagnosis: the slow course of the disease, with little subjective trouble, and the appearance of nummular or lenticular spots in the epithelium, which enlarge slowly and coalesce to form escalloped patches of varying size. These end abruptly at the normal portion of the cornea. The lesion has the grayish color of frosted glass, but in some vascularized areas it becomes salmon colored. On its surface globular, translucent, gelatinous excrescences are observed. Vascularity of the cornea is scant, and the vessels are intraepithelial; interstitial vessels were not encountered in the present case. In this case the vessels were dendritic and stopped after penetrating the lesion a few millimeters, before returning to the limbus. On examination with the slit lamp one could see that the lesion lay above Bowman's membrane and that the globular excrescences of the epithelial surface were due to thickenings of the epithelial layers. The parenchyma maintained its appearance and normal transparence throughout.

Surgical therapy is effective, as the lesion may be totally removed without further complications and a clear cornea left. It is interesting to note that in the present case the ocular lesion was the only manifestation of Bowen's disease. Neither the skin nor the mucous membrane was involved.

Since a specimen for biopsy can be taken from the surface of the cornea without evil consequences to the patient, histologic study should be undertaken more often when Bowen's disease of the cornea is suspected clinically. The benefit to the patient will be greater, as early diagnosis aids in recovery, before the growth undergoes malignant change. Personally, I think that many new cases would be detected if biopsy of specimens from the cornea were made more often.

SUMMARY

Some dermatologists classify Bowen's disease as precancerous dyskeratosis; others consider it as cancerous from its onset.

In the case of Bowen's disease reported here, a man aged 56 presented on each cornea patches of grayish, ground glass appearance, formed by the coalescence of numerous minute, rounded spots. On the surface occurred little translucent protrusions of gelatinous tissue. The parts of the plaque near the limbus were somewhat vascularized. The lesions were superficial and ended abruptly at the normal portion of the cornea. Histologic examination revealed that the lesion was an epithelioma which had developed within the epithelium, without breaking through the basement membrane. Large, clear cells with irregular nuclei and cells of the so-called dyskeratotic type, exactly as they appear in cases of Bowen's disease of the skin, were demonstrable.

The skin was normal, but in the mucous membrane of the lower lip an area of leukoplakia was present.

As the corneal lesion was superficial, it was totally excised. Removal of the area left a clear cornea. Vision improved from ability to count fingers at 3 meters to 2/3 with Snellen's chart.

Laprida 1159.

DIAGNOSTIC VALUE OF MONOCULAR OCCLUSION

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HANOVER, N. H.

The ophthalmologist frequently fails to give his patient comfortable binocular vision in spite of the fact that he has adequately corrected errors of refraction and motility and has eliminated the possibility of ocular disease and inflammation. The reason for this may be that some disorder of binocular vision is at fault. Of interest, therefore, is a report of the results obtained in a series of cases studied at the Dartmouth Eye Institute in which monocular occlusion was used for the purpose of determining whether binocular anomalous vision was at fault.

The chief disorders affecting the comfortable and efficient cooperation of the two eyes in binocular vision are heterophoria, accommodation-convergence imbalance and aniseikonia. Binocular single vision is not present in cases of strabismus, and symptoms in such cases cannot be due to disorders of the binocular processes. On the contrary, correction of the deviation and restoration of binocular vision may result in production of eyestrain of binocular origin, although the patient previously had no symptoms because he had been suppressing the image of the deviating eye. In fact, monocular suppression, which is quite analogous to monocular occlusion, may be nature's way of dealing with binocular defects which make binocular vision uncomfortable.

If binocular vision is interrupted by the occlusion of one eye, then such causal factors of eyestrain as heterophoria, disturbances of the accommodation-convergence relationship and aniseikonia have been eliminated, and the neuromuscular mechanism concerned with binocular vision is relieved of many fine and exacting adjustments. Relief from symptoms during a period of monocular occlusion, which eliminates the disorders of binocular vision aforementioned, should lead one to believe that some binocular difficulty is present. It must then be determined what binocular factor is at fault. Occlusion studies sometimes do more than establish the cause of the patient's symptoms; they may point to the advisability of adopting the practice as a therapeutic measure.

Marlow has contributed most to the literature on monocular occlusion. He claimed to have begun the use of monocular occlusion for diagnostic purposes as early as 1894,[1] although his first paper did not appear until 1897,[2] when a patient he had been treating complained of diplopia after having had one eye bandaged for a week. The patient had never had double vision before, and Marlow expressed the belief that monocular occlusion might be a new aid in bringing out latent muscular deviations.

Marlow published a monograph [3] on monocular occlusion in 1924, with statistics on 700 cases. It was on the results in these cases that he based the value of his test. He used monocular occlusion primarily to uncover latent heterophoria. His procedure was to cover the nondominant eye, using either a ground glass spectacle lens or black court plaster on the spectacle lens. Marlow insisted that monocular occlusion had much greater value when the eyes were dissociated for from three to seven days.[4]

In 1938,[5] after using the test for over forty years, Marlow drew the following conclusions from his experience with the prolonged occlusion test: He expressed the belief that heterophorias and disturbances in duction could all be accounted for on an evolutionary basis, and by no other conceivable hypothesis, and that the evolution of the race and the development of the individual concur in furnishing an explanation at least for the lateral deviations, particularly exophoria. He stated the opinion that conditions such as overdevelopment, faulty insertion or abnormal length of a muscle, declinations (as described by Stevens), aniseikonia and paresis are underlying anatomic states rather than causes.

Many eminent ophthalmologists [6] have used the occlusion test with good results and have

Read before the Section of Ophthalmology, New York Academy of Medicine, Jan. 17, 1944.

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2. Marlow, F. W.: Note on the Use and Non-Use of the Occlusive Bandage in Cases of Heterophoria, Ophth. Rec. **6**:115-118 (March) 1897.

3. Marlow, F. W.: The Relative Position of Rest of the Eyes and the Prolonged Occlusion Test, Philadelphia, F. A. Davis Company, 1924.

4. Marlow, F. W.: Prolonged Monocular Occlusion as a Test for Muscle Balance, Am. J. Ophth. **4**:238 (April) 1921.

5. Marlow, F. W.: A Tentative Interpretation of the Findings of the Prolonged Occlusion Test on an Evolutionary Basis, Arch. Ophth. **19**:194-204 (Feb.) 1938.

6. de Schweinitz, G. E., in discussion on Appleman, L. F.: A Method of Uncovering Latent Hyperphoria,

(Footnote continued on next page)

written favorably about it. When Fuchs [7] visited the United States, he was favorably impressed with this test, having observed its use by a number of American ophthalmologists. Worth [8] listed occlusion as one of the steps in the diagnosis of the ocular deviation. He claimed that occlusion of the good eye served to develop the acuity, fixation and rotations of the squinting eye and made possible more accurate retinoscopy and subjective refraction. In spite of some theoretic objections to the test, Hughes [9] claimed that it is of inestimable value in cases of obscure symptoms which are believed to be of ocular origin.

Monocular occlusion has not been universally accepted. Duane and Berens,[10] for example, questioned the value of the test, insisting that it did not reveal true hyperphoria but caused an artificial dissociation of the visual planes. This was Lancaster's [11] belief. He gave up the test as a method of measuring the amount of heterophoria but continued to use it in treatment of the symptoms of heterophoria and other defects of binocular vision. He expressed the belief that a positive result (relief from symptoms following monocular occlusion) was strong proof that the patient's symptoms were due to a disturbance of binocular vision. In many cases, if relief could not be obtained by treatment of these defects, he advised the patient to continue monocular occlusion indefinitely—for example, for all near work. Lancaster stated that he was convinced, however, that failure to get relief from symptoms does not necessarily prove that binocular vision is not at fault.

Zentmayer [12] has never written on monocular occlusion. He stated, however, that he had used it to some extent in his office practice. He said he was not convinced that the monocular occlusion test is a satisfactory way of uncovering latent muscular imbalance and that he would be influenced by the result only in a case in which the usual methods had given contradictory and variable evidence.

Abraham [13] questioned the value of the test on the ground that it demonstrated Bell's phenomenon, a normal sign, in which the covered eye turns upward and outward, as in sleep or the early stages of anesthesia, so that the test could not be a method of uncovering latent heterophoria. Beisbarth [14] stated his opinion that the test was impractical, basing his objections on a series of 29 cases. He asserted that the good results claimed by some authors could be accounted for by the fact that they had not prescribed full correction for the amount of heterophoria measured after occlusion.

Marlow [15] replied to the criticisms of Abraham and Beisbarth by discounting their adverse results on the grounds of inadequate procedure, too short a period of occlusion (one to twenty-four hours only), too few cases and incomplete observations. Marlow [15] admitted that prescribing for the heterophoria is not always simple. He pointed out that the amount of the error alone was not the deciding factor, but that one's decision must be controlled, or modified, by a comparison of the fusional amplitudes, the amount of the heterophoria in different directions of gaze and the difference brought out by occlusion of the other eye.

Duke-Elder [16] spoke of binocular vision as a perceptual process of considerable complexity and divided it into two stages: First, a sensory image is elaborated simultaneously by each uniocular mechanism, and second, if the two images are suitable, they are fused into one by a perceptual process on a higher level.

Up to the present, little attention has been paid to the possibility that aniseikonia is the binocular anomaly at fault when a patient's symptoms have been partially or wholly relieved by the occlusion of one eye. Since aniseikonia (a relative difference in size and/or shape of the ocular images) is a binocular anomaly, it is reasonable to assume that persons suffering from this disturbance should be relieved of their symptoms when binocular vision is suspended. It be-

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7. Fuchs, E.: Subjective Symptomatology of Ocular Disorders, Am. J. Ophth. **13**:113-117 (Feb.) 1930.

8. Worth, C.: Worth's Squint, edited by F. B. Chavasse, ed. 7, Philadelphia, P. Blakiston's Son & Co., 1939, p. 435.

9. Hughes, W. L.: Prolonged Occlusion Test, Arch. Ophth. **11**:229-236 (Feb.) 1934.

10. Duane, A., and Berens, C., Jr.: Ocular Movements, Ophth. Lit. **17**:53, 1921.

11. Lancaster, W. B.: Personal communication to the authors.

12. Zentmayer, W.: Personal communication to the authors.

13. Abraham, S. V.: Bell's Phenomenon and the Fallacy of the Occlusion Test, Am. J. Ophth. **14**:656-664 (July) 1931.

14. Beisbarth, C.: Hyperphoria and the Prolonged Occlusion Test, Am. J. Ophth. **11**:1013-1015 (Nov.) 1932.

15. Marlow, F. W.: Recent Observations on the Prolonged Occlusion Test, Am. J. Ophth. **16**:519-527 (June) 1933.

16. Duke-Elder, W. S.: Text-Book of Ophthalmology, St. Louis, C. V. Mosby Company, 1940, vol. 1, p. 1038.

comes still more imperative to consider aniseikonia as the causative factor in cases of occlusion in which no latent heterophoria or any disturbance of the accommodation-convergence relationship is revealed.

PRESENT STUDY

During the past two years we have accumulated data on a series of 80 patients who had recourse to monocular occlusion. Many of these patients had resorted to closing one eye of their own accord. They had become aware of the fact that what they had regarded as a habit had gained for them relief from distressing symptoms which were present whenever they used their two eyes together. With a few of the patients monocular occlusion had been tried for diagnostic purposes by other physicians. Some of the patients were referred because their symptoms were relieved by occlusion, and other therapeutic measures had failed to help them. With a large number of the patients occlusion was resorted to when correction of the usual ocular defects had failed to give relief.

The Dartmouth Eye Institute devotes special attention to the study of eyestrain, and refractive errors are looked on as its most frequent cause. The great number of patients with problem cases who come to the Institute have repeatedly had their refractive errors measured and corrected elsewhere.

We examined the refraction of this series of patients with great care, using methods of measuring the accommodation and refraction which were far beyond those in general use. When required, examinations were made with cycloplegia, and stigmatoscopy was also employed. The final check in the more troublesome cases was made by Dr. Walter B. Lancaster, who was our chief at that time.

Of the 80 patients, 56 (or 70 per cent) obtained partial or complete relief from their chief symptoms while they had monocular occlusion. Nineteen patients reported having received no relief whatever, a few stated that their condition was worse, and 5 gave indefinite information. Of the total number, 49 were found to have a significant degree of aniseikonia, and 9 a significant amount of latent heterophoria, after the occlusion of one eye. Twenty patients had both aniseikonia and a motor anomaly. Two patients showed no binocular anomaly.

The number of patients with aniseikonia was relatively higher than the number with latent heterophoria. This is explained by the fact that a greater number of the patients were referred to the Institute primarily because aniseikonia was suspected and motility factors had been fairly well ruled out. There is no doubt that we have occasion to employ monocular occlusion more often than one would find necessary in the average ophthalmic practice. But no practice lacks that small group of patients with whom all measures have failed to give relief from their distressing and persistent symptoms. These patients constitute an important group for diagnosis and treatment.

The results obtained with our group of 80 patients are tabulated as follows:

Total no. of patients	80	(100%)
No. with binocular anomaly corrected.	62	(77%)
No. relieved	44	(55%)
No. not relieved	18	(22%)
No. who continued monocular occlusion as therapeutic measure	11	(14%)
No. with indefinite or no report	7	(9%)

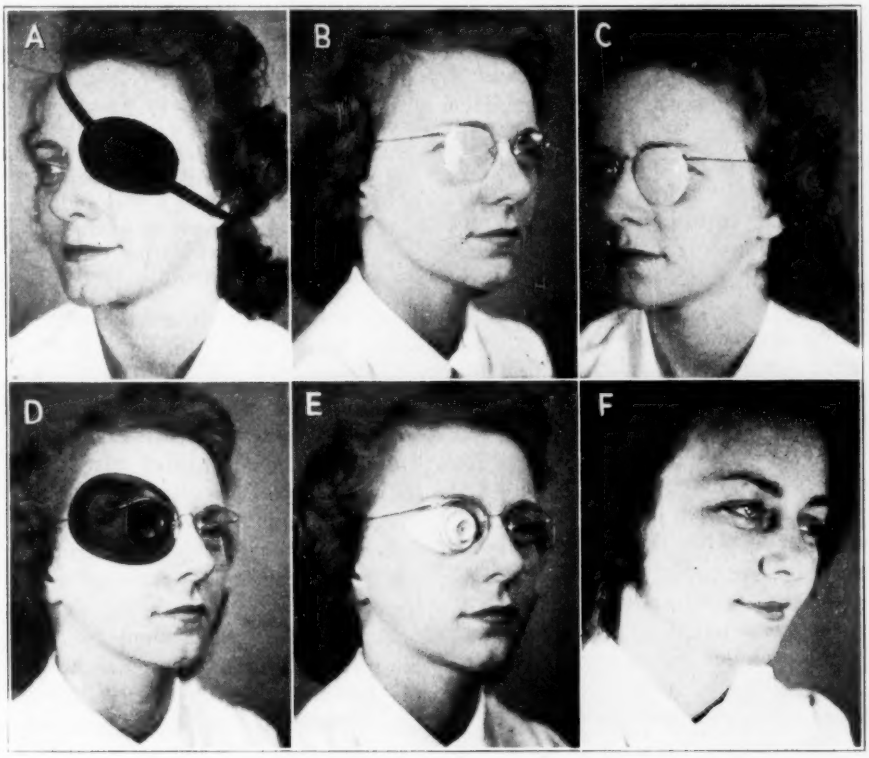
Our technic begins with the taking of the patient's history. Many patients, on being questioned, report that they have found they could read, watch a movie or baseball game or travel by car or train much more comfortably with one eye closed or covered. Some people speak of closing one eye habitually in bright sunlight; again, the eye of a patient has been seen to close as a reflex act, so that annoying diplopia is prevented. Such information is important in the later evaluation of the patient's binocular performance.

When monocular occlusion is decided on, its purpose should be clearly explained to the patient. He must be assured that no harm can come from his having one eye covered. The patient should be warned of the necessity of becoming accustomed to one-eyed vision and of the inability to judge distances accurately with one eye alone. It is well to caution him about going through doorways and up and down stairs, pouring liquids and setting things down, and against driving a car or working in a hazardous occupation.

Members of the staff have at different times employed monocular occlusion for several days in order to become familiar with the peculiarities of monocular vision and the changes in phoria following occlusion. It is helpful to try monocular occlusion with a few persons who have no symptoms in order to gain knowledge of the normal changes in the measurement of phoria following monocular occlusion and of the annoyance of one-eyed vision itself to persons who enjoyed comfortable binocular vision before the test. If a patient reports that his having one eye covered was a bit annoying, but not nearly as troublesome as his headaches were, one can better realize how much of a burden his headaches must have been.

There are many ways of occluding one eye. Marlow [1] used a ground glass lens or a black court plaster. If a patient does not wear glasses, gauze and cotton held in place over the eye by a black patch (figure, *A*) can be employed. This necessitates his keeping the lid closed, which is often objectionable.

There are many types of translucent lenses which prevent fusion and afford partial occlusion (figure, *B*). A flesh-colored bakelite shield (figure, *C*) made to fasten on the front of the spectacle lens is often quite satisfactory. It does not give complete occlusion, as light enters from the sides. The large, black, soft rubber occluder (figure, *D*) provides complete occlusion and, at the same time, allows the occluded eye to remain open. It is, however, warm and conspicuous to wear. The best type of occluder [17] that we have used is one which is attached by suction to the back of the lens and fits around the orbit (figure, *E*). It is relatively inconspicuous and is light in weight. It permits the eye behind it to remain open and cuts out most of the light from the sides. The most inconspicuous occluder possible is an opaque contact glass (figure, *F*), with which some of our greatest successes, from a therapeutic standpoint, have been obtained.



Types of monocular occluders.

It is of little value to try monocular occlusion for a few hours only—in fact, even for one or two days. In order for the test to be of value, occlusion of one eye should be maintained for at least two weeks. In general, most patients are more annoyed than helped by only a few days' occlusion; relief from symptoms of binocular origin can be masked by the more or less temporary annoyances of one-eyed vision.

Measurements of the degree of heterphoria should be made immediately on removal of the occluder. One should be familiar with the range of these measurements after prolonged occlusion of one eye, since it is known that a covered eye tends to turn upward and outward. Whenever a hyperphoria is measured after the occlusion of one eye one should occlude the other eye for a similar period and repeat the tests. An alternating hyperphoria, termed dissociated vertical divergence by Bielschowsky,[18] is often met with when occlusion is carried out on the other eye. This is a purely innervational type of deviation and is not amenable to correction by either prisms or surgical means. We have repeatedly observed that the vertical fu-

17. The Watchemoket Optical Company's "Vac Cluder."

18. Bielschowsky, A.: Lectures on Motor Anomalies of the Eyes: Physiologic Introduction, Arch. Ophth. **12**:805-818 (Dec.) 1934.

sional amplitudes in cases of dissociated vertical divergence are higher than normal and may be equal.

The amount of lateral heterophoria measured after occlusion offers no new problem. One deals with it in the usual manner. Frequently, there is more exophoria (or less esophoria) after occlusion. The amount of error alone cannot be the deciding factor in the prescription for heterophoria after occlusion. The fusional amplitudes, for both distant and near vision, with the measurements repeated, after the occlusion of the other eye, must all be taken into consideration before the final prescription or the treatment of any latent heterophoria is decided on.

At the Dartmouth Eye Institute monocular occlusion is not employed solely as a means of uncovering latent heterophoria but is used as a test to determine whether a binocular anomaly may be causing the patient's trouble. If a patient has found relief from his chief symptoms during the occlusion test, consideration is given not only to factors previously considered by others who tried occlusion but to the binocular anomaly of aniseikonia. The important information to be gained from the occlusion test, it is believed, concerns whether there is any relief from symptoms. A negative report is not conclusive evidence that no binocular trouble is present. The patient himself can decide whether his annoyance with monocular vision was greater or less than that, for instance, which he had experienced from his headaches. His report made after occlusion must be carefully weighed against statements before occlusion was tried. A patient may complain at great length of his discomfort while he wore the occluder, but only on his being questioned will he admit that he had no headache after the first three or four days. In general, patients who have suffered for years will gladly submit to the occlusion test. If they obtain only partial relief from their symptoms, they feel encouraged and will follow the treatment and advice with renewed hope.

A high percentage of our patients were given relief by correction of their binocular anomaly. A few could not be given comfortable binocular vision but were later provided with comfortable monocular vision. Dr. Walter B. Lancaster devised a treatment for 2 such patients by prescribing an opaque contact glass, with an iris painted on the glass to match that of the other eye. In 1 of these patients, a young woman, a lesion developed in the fovea of one eye from exposure to very bright light while she was polishing a concave telescopic mirror. The second patient had constantly fluctuating heterophoria and obtained complete relief with an opaque contact glass. A third patient had had a successful operation for detachment of the retina but could not obtain binocular vision in the area of binocular fixation because of macular micropsia, although there was good fusion in his peripheral fields. He adopted permanent occlusion willingly in order to avoid the confusion caused by the overlapping of small objects centrally fixated.

Eight other patients in our series have resorted to some form of monocular occlusion in order to be comfortable. Interesting data are set forth in the following tabulation:

Total number of patients	80	(100%)
Patients relieved during occlusion	56	
No. of these relieved by treatment	47	(59%)
Patients not relieved during occlusion	19	
No. of these not relieved by treatment	13	(16%)
No. of these relieved by treatment	5	(6%)
Patients with indefinite results with regard both to test and to treatment	11	(14%)
Patients with relief during occlusion but not with treatment	4	(5%)

Fifty-six patients in the entire series were given some relief during occlusion. Of these, 47 obtained relief through correction of their binocular anomalies, which were revealed by the occlusion test. This is evidence of the positive value of the occlusion test. This series of patients stood an 8:10 chance of obtaining ocular comfort by correction of heterophoria or aniseikonia or a combination of the two anomalies. Five of the 19 patients who reported that they had no relief during occlusion obtained ocular comfort when their binocular difficulties were treated. These patients stood a 1:4 chance of obtaining relief by correction of their binocular difficulties, although the occlusion test gave negative results.

SUMMARY AND CONCLUSIONS

Comfortable binocular vision is frequently not obtained because the anomalies of binocular vision have not been taken into consideration.

While monocular occlusion is generally employed for the purpose of discovering latent heterophoria, we advocate it as a means of determining whether any of the various binocular anomalies are at fault.

In the series of patients reported on for whom monocular occlusion was employed, consideration was given not only to latent heterophoria but to disturbances of the accommodation-convergence relationship and to aniseikonia.

Dartmouth Eye Institute.

CATGUT SUTURES FOR CLOSURE OF THE DEEP CORNEOSCLERAL WOUND IN OPERATIONS FOR CATARACT

A PRELIMINARY REPORT

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The growing popularity of some form of suture of the so-called deep corneoscleral wound in operations for cataract has led me to try most of the types of sutures recommended by various surgeons. Difficulties have been encountered in insertion of many of these sutures while some, in my opinion, produce an unsatisfactory closure of the wound. For this reason I have recently tried various types of catgut. With the use of catgut one may insert one or more sutures in the deep wound and completely cover the wound with a conjunctival flap, the latter being sutured separately with silk.

METHOD

I prefer to make the usual limbal section with a von Graefe knife, with a complete conjunctival flap covering the entire deep corneoscleral wound. This can be most easily accomplished if the conjunctiva is pushed down with a spatula, or other semisharp instrument, before the section is begun, which frees it at the limbal borders.

The point of the knife is first inserted beneath the conjunctiva about 2 mm. from the limbal border, at the site chosen for the section, and advanced to the limbus, and the corneoscleral incision is begun in the usual manner. After the counterpuncture a similar lip of conjunctiva is obtained and the section completed, the incision being carried deep enough to permit a complete conjunctival flap throughout.

After the section, depression of the knife usually aids in securing a flap of the desired size. Also, one may obtain a slight scleral lip at 12 o'clock. After the section one plain five 0 catgut suture, fitted in a fine needle with a cutting edge, is immediately inserted and the loop drawn aside. To insert the suture, the corneal lip of the wound is grasped with forceps, and the needle is inserted through the outer third of the margin of wound, after which the needle is similarly inserted immediately opposite in the outer, or scleral, lip of the wound. When the suture is tied, perfect apposition of the lips of the wound is obtained. At times I have used two or more catgut sutures, especially if the corneal side of the wound could be easily grasped. At the end of the operation the conjunctival incision is closed with six or more silk sutures. Two of these can be inserted before delivery of the lens if one is apprehensive. The cataract is then removed in the manner desired and the catgut suture immediately tied with two or three knots.

The insertion of the needle into the corneoscleral wound is not easy and requires great delicacy and care in manipulation to avoid undue trauma to the globe. If one uses the keratome-scissors technic in opening the globe, the suture is more easily inserted. When employing this technic, I usually dissect an ample conjunctival flap 4 mm. wide at its highest point and tapering to the sides. The keratome can be so introduced that one is certain of obtaining a good scleral lip on the corneal border of the incision for insertion of the suture. The needle is more easily inserted before the wing sections are completed with the scissors.

COMMENT

My series of operations, while considerable, is not yet large enough to justify one's drawing any final conclusions concerning the efficacy of the buried catgut suture, but so far its use has proved entirely satisfactory. The lips of the deep wound have remained in perfect apposition, with no spreading or separation. The conjunctiva has shown no bulging or elevation over the suture, and the reaction has been no greater than that which is generally encountered after the same procedure without the deep suture.

Most of the patients could have been discharged from the hospital on the tenth or twelfth day. In 1 case the patient refused to permit the use of a patch on the eye which was not operated on. The operative wound healed perfectly, with almost no reaction, and the patient was ready for discharge on the twelfth postoperative day in spite of this unusual practice.

The plain catgut disappears completely and usually cannot be identified at the end of a week. Chromic catgut requires a much longer period for complete absorption. In a case in which a five 0 chromic catgut suture was used and tied with three knots the catgut absorbed slowly, and at the end of two weeks part of the knot eroded through the conjunctiva. However, this in no way interfered with prompt and firm closure of the deep wound. Plain catgut is more pliable and absorbs much more quickly and completely, and therefore should be preferred. It has so far proved more satisfactory than the chromic gut, for the reason indicated.

Finer catgut, that is, six 0 or seven 0, would be preferable, but so far I have been unable to obtain it.

From the Department of Ophthalmology, University of Wisconsin Medical School.

The use of buried catgut sutures affords the surgeon the opportunity to make the section unhampered by preplaced sutures, or partial incisions, which, in my opinion, interfere with, and at times mar, the beauty and precision of the free von Graefe incision.

Since I introduced the use of buried catgut sutures in operations for strabismus, in 1934,[1] my associates and I employed buried catgut sutures in more than 500 operations for strabismus, without a single deep infection. Superficial conjunctival sutures slough out or break down at times, but in no instance that I can recall has the deep suture become loosened or infected. Occasionally a conjunctival cyst has developed, possibly as a result of irritation from the buried chromic catgut, but such a complication has been rare. In cases of operation for strabismus swelling over the site of the sutures in both the recession and the resection procedure sometimes occurs and may last for some time. This has not yet occurred in my cases of cataract extraction. I am at present trying various types of needles, but I find an atraumatic needle supplied by Davis & Geck, Inc., the most satisfactory.

A more complete report will be made when a larger series of operations has been completed and the final results are evaluated.

NOTE.—Since this article was submitted for publication, my associates and I have used buried catgut sutures in more than 70 extractions. No unusual complications have been encountered, although postoperative hyphemia has been observed in a few cases. Slight swelling beneath the conjunctival flap developed in some instances, apparently due to edema incident to the liquefaction and absorption of the catgut. This usually absorbs completely by the end of the fourteenth day or sooner. No undue irritation seems to accompany this slight swelling, nor has the conjunctival flap failed to flatten out with its disappearance. As already stated, however, in most cases there is little visible evidence of the suture aside from a small light spot at the site of the knot.

The deep corneoscleral wound has been observed to be firmly closed, without exception, at the time of the first dressing, usually on the fourth postoperative day, with full restoration of the chamber. No subsequent spreading of the wound has been seen; so it is assumed that the swelling of the flap occasionally encountered is incident to the presence of the catgut. However, it is completely absent in most cases. I have not yet been able to determine why the swelling is present in some cases and is absent in others.

We are now using plain catgut exclusively in cases in which this technic is employed, since it unquestionably absorbs more quickly and seems to hold the wound sufficiently tight to permit firm closure before absorption takes place. The suture is tied firmly with two knots, and the ends are cut short in order to reduce the amount of gut for absorption.

It is surprising how little irritation accompanies the presence of the catgut. The eye shows no more reaction than is usually seen with cataract extractions. Occasionally injected blood vessels in the flap may persist for a short time, but deep inflammation of the globe or severe iritis has not so far been encountered.

The suture seems to be safe; it is relatively simple to introduce as compared with many other kinds, and to surgeons who are advocates of the conjunctival flap it offers the advantage of a complete covering of the deep wound, which, in my opinion, is highly desirable.

224 West Washington Avenue.

1. Davis, F. A.: Modification of Jameson Recession Operation for Strabismus, Arch. Ophth. **11**:684-687 (April) 1934.

TWO PLASTIC OPERATIONS FOR REPAIR OF ORBIT FOLLOWING SEVERE TRAUMA AND EXTENSIVE COMMINUTED FRACTURE

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War injuries of the middle third of the face may result from head-on crashes in motor and aviation accidents and from the unpredictable ravages of bullets or bomb fragments.

In crash accidents, when the head is thrown straight forward, severe comminution of the bones of the "interorbital region" (nasal pyramid, lacrimal and ethmoid bones) may result. Comminution and posterior displacement may produce considerable overriding of the fragments, as well as displacement of the internal palpebral ligament, resulting in a marked deformity (fig. 1 *A*). If the head is thrown forward while turned laterally, the malar region may present multiple fractures, with resultant displacement of the floor of the orbit into the antrum (fig. 5 *A*). It is evident that immediate replacement of the displaced bones is the method of choice. New methods of early treatment of such injuries have been described elsewhere.[1]

Two cases are presented to illustrate methods of late reconstruction.

CASE 1.—*Reconstruction following disorganization of the medial wall of the orbit and the nasal bones by a bomb fragment.*

W. L., a man aged 23, was wounded in an air raid on May 8, 1941, when a bomb struck his home, killing all the other members of his family. A fragment of the bomb entered the left preauricular region, penetrating the orbit and the nasal cavity and making its exit through the right lateral aspect of the external nose. Six months later the patient was seen for repair of a saddle nose, due to destruction of the cartilaginous support, of most of the nasal lining and of the nasal bones. The remains of the left nasal bone and of the ascending process of the maxilla on the left side appeared to have been pushed into the ethmoid sinus (fig. 2 *A*). The whole region of the inner canthus of the left eye was widened (fig. 2 *B*). The eyeball seemed to have been pushed laterally (fig. 1 *A*). Vision was lost in the left eye, as a result of section of the optic nerve. Plastic repair was planned in two stages: (1) correction of the deformity of the inner canthus and (2) repair of the nasal deformity.

Operation (Feb. 15, 1942).—With local anesthesia, induced with a 1 per cent solution of procaine hydrochloride to which had been added epinephrine hydrochloride (10 drops of a 1:1,000 dilution to each 100 cc. of anesthetic), which was allowed to infiltrate along the medial wall of the left orbit, an incision about 5 cm. in length was made, starting laterally and extending to the medial end of the eyebrow (fig. 3). Subperiosteal elevation of the tissues was done with a small elevator; the disinserted internal palpebral ligament was defined; the scarred remains of the lacrimal sac was visualized, and, with the dissection continued back over the overriding osseous fragments, the os planum of the ethmoid bone and the anterior ethmoidal artery and nerve were exposed. The protruding bone was resected with a fine osteotome and a rongeur (fig. 3) until the bony wall appeared to be on the same plane as the os planum farther back. The remains of the sac were removed, as there was not enough of the sac left to permit a Toti-Mosher operation. The inner canthus of the left eye tended to resume its normal place. The internal palpebral ligament was then sutured to remains of periosteum with a gage 35 stainless steel wire (fig. 4). (The ligament could also be sutured to the bone by looping the wire through two small holes drilled in the bone without perforation of the nasal mucosa.) The cutaneous incision was then carefully sutured with fine interrupted silk sutures.

Fig. 1.—*A*, appearance before replacement of the medial canthus; *B*, appearance after replacement of the medial canthus and reconstruction of the nose.

The result of the operation eliminated the unilateral mongoloid appearance. The nasal deformity was later repaired (fig. 1 *B*). The type of operation performed in this case should be valuable in all cases in which traumatic splaying of the nasal bones or telescoping of the bones into the ethmoid cells has produced widening of the intercanthal distance.

From the American Hospital in Britain and Churchill Hospital, Oxford, England (1940-1942).

1. Converse, J. H.: Some Aspects of Emergency Plastic Surgery in War Injuries of the Face, Ann. Otol., Rhin. & Laryng. **52**:637 (Sept.) 1943.

CASE 2.—*Reconstruction of the floor of the orbit after comminution, with downward displacement of the eyeball.*

W. G., aged 21, a private in the British army, received severe injuries to the head on Feb. 24, 1942, sustained by his striking a large rock on the roadside when he leaned his head out of an army truck which was traveling at high speed. He was treated in an emergency hospital for multiple lacerations of the face, fracture of the mandible and maxilla and comminuted fracture of the malar bone, with depression into the antrum. At this emergency hospital the fractures of the jaw were treated and the lacerations sutured, but no attention was given to the fractured malar bone. Three months later I saw the patient; at this time plastic repair of the floor of the orbit was under consideration because of persistent diplopia. Movements of the extraocular muscles were normal. The left eyeball appeared lower than the right; comparative measurements showed that the floor of the left orbit was 18 mm. lower than the floor of the right orbit (fig. 5 *A*). Diplopia was constant and necessitated his wearing a patch over the left eye.

Operation (June 16, 1942).—With the use of spinal anesthesia induced with procaine hydrochloride, an incision, 12 cm. in length, was made over the crest of the right ilium posterior to the anterior superior spine. The periosteum was incised and elevated, together with the muscular attachments to the crest. The inner table was exposed by elevation of the iliac muscle. With the aid of osteotomes, a piece of bone 5 by 4 by 3 cm. was removed from the inner table of the ilium. The wound was then closed, plane by plane, with interrupted silk sutures.

With local anesthesia and infraorbital block induced with a 1 per cent solution of procaine hydrochloride containing epinephrine hydrochloride, an incision was carried along the whole length of the lower lid, in one of the cutaneous folds; the orbicularis muscle fibers were split, and the periosteum along the lower border of the orbit was incised and elevated along the entire length of the floor (fig. 6). A calibrated, double-bladed instrument was then introduced and used to elevate the eyeball. The patient's diplopia was then tested, but his answers were contradictory. The bone graft was shaped with the aid of the Albee electric saw and fitted into position, the eyeball being elevated 18 mm. The periosteum and the orbicularis muscle were then sutured with fine catgut, and the skin was closed with fine interrupted silk sutures. A drop of atropine solution and boric ointment were instilled in the eye. A pressure dressing was used and was

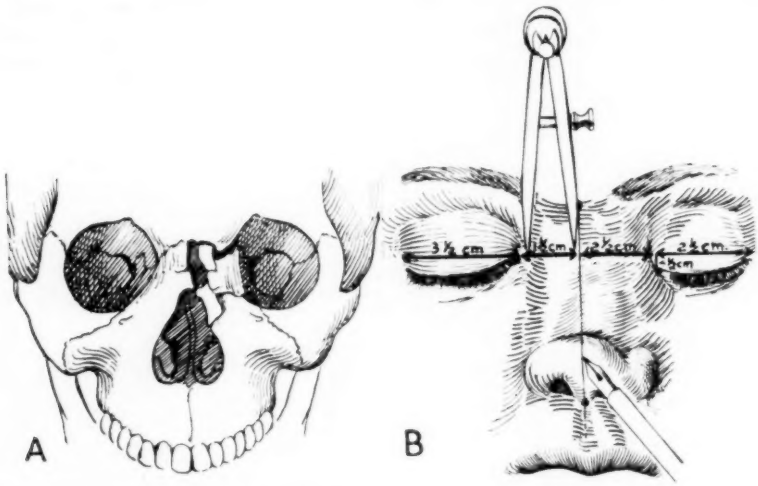

Fig. 2.—*A*, diagrammatic representation of displacement of bone, which penetrates the orbital cavity; *B*, measurement of lateral displacement of the left medial canthus.

Fig. 3.—Drawing showing removal of a fragment of bone which is projecting into the orbit.

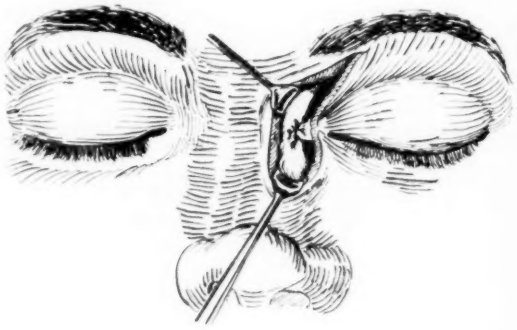

Fig. 4.—Suture of the internal palpebral ligament into the periosteum.

left undisturbed for five days. Two weeks after the operation the diplopia had disappeared except in extreme upward gaze. The patient's appearance was considerably improved (fig. 5 *B*). (A small rotation flap corrected the ectropion.)

COMMENT

This procedure is not new. Cartilage (costal) has been used to elevate the eye.[2] The inconvenience of cartilage, however, is its tendency to curl, which renders its use less precise than

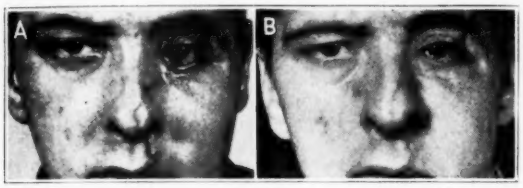

Fig. 5.—*A*, ptosis of the floor of the orbit, with diplopia; *B*, after elevation of the orbital floor by a graft from the ilium.

that of bone. Bone grafts from the ilium have been employed in the orbit by Gillies, in England. Bone grafts have also been used in the repair of noses and defects in the skull and as contour material around the face. There is clinical evidence of their reossification and survival when they are placed subperiosteally, against bone. Wheeler [3] advised the use of fascia lata, but this has the disadvantage of not being sufficiently solid and firm to bring about a suitable elevation. The present tendency toward the use of acrylics as buried material might well find an application in the reconstruction of the floor of the orbit, either as a temporary support, before the introduction of bone, or as a permanent means of reconstruction.

DISCUSSION

DR. R. TOWNLEY PATON, New York: Dr. Converse has made a valuable suggestion in the use of stainless steel wire to reattach the internal palpebral ligament. Often the periosteum has been destroyed in this region, so that a poor cosmetic result is obtanied in an attempt at reattachment.

His most valuable suggestion is the method described for elevation of an eye after fracture of the floor of the orbit; this may be applied after enucleation in cases in which there is downward displacement of the prosthesis. The cosmetic result obtained after the removal of old phthisical eyes is often discouraging, the poor effect being due to sagging of Tenon's capsule and loss of elasticity of the tissues in and about the orbit. Ptosis of the lower lid frequently accentuates the condition, and there may be slight ectropion as a further complication. It has been my experience that a modified Kuhnt-Szymanowski operation, for repair of ectropion, is not sufficient to draw the artificial eye upward, even when both cul-de-sacs are large and roomy. A disfiguring narrowing of the palpebral fissure may result from this method of treatment, whereas the operation described by Dr. Converse, which employs a bone-shaped wedge, is especially applicable. The only difference is that the implant in Tenon's capsule is elevated, and not the eyeball, as in the case just described. It is a confession of weakness on the ophthalmologist's part that he does not use bone implants more frequently and that fat and cartilage are used as substitutes. In 2 cases a good cosmetic result was obtained by removal of the gold ball implant and its reinsertion in Tenon's capsule after a

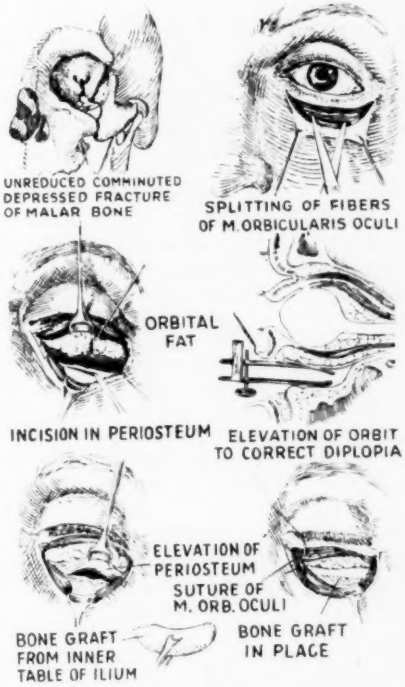
UNREDUCED COMMINUTED DEPRESSED FRACTURE OF MALAR BONE
SPLITTING OF FIBERS OF M. ORBICULARIS OCULI
ORBITAL FAT
INCISION IN PERIOSTEUM
ELEVATION OF ORBIT TO CORRECT DIPLOPIA
ELEVATION OF PERIOSTEUM
SUTURE OF M. ORB. OCULI
BONE GRAFT FROM INNER TABLE OF ILIUM
BONE GRAFT IN PLACE

Fig. 6.—Drawings (D. Stilwell) illustrating steps in elevation of the floor of the orbit with a bone graft.

tuck was taken in the lower surface of the capsule. This method is not to be recommended, however, as it may lead to serious impairment of the function of the ocular muscles. The use of vitallium wedges for this purpose will be discussed later.

927 Park Avenue.

2. Spaeth, E. B.: The Principles and Practice of Ophthalmic Surgery, Philadelphia, Lea & Febiger, 1939, pp. 74-76.

3. Wheeler, J. M.: Operative Replacement of Dislocated Inner Canthus and Depressed Outer Canthus: Filling of Sunken Orbit with Fascia Lata, in Collected Papers of John M. Wheeler on Ophthalmic Subjects, New York, Columbia University Press, 1939, pp. 425-429.

PRACTICABILITY OF USE OF CONTACT LENSES AT LOW ATMOSPHERIC PRESSURES

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Present standards for personnel of military planes require that crew members have good vision without glasses. The use of ordinary spectacles is considered impractical. Since many persons otherwise qualified are excluded from this branch of the service, in a time of great need, by reason of ametropia, the question may be fairly asked, "Can contact lenses be used practicably in planes at the altitudes commonly attained in modern warfare?" The observations here reported were made in an attempt to answer this question.

Numerous studies of ocular function have been made under conditions of low atmospheric pressure, and hence low partial pressure of oxygen. These studies were reviewed by McFarland, Evans and Halperin.[1] In modern flying, plane personnel need not experience lack of oxygen, since oxygen may be supplied by means of a mask. A normal supply of oxygen to the cornea via the blood stream and the intraocular fluid may therefore be maintained. When only the mouth and nose are included in the mask, however, the cornea is exposed to an atmosphere of low oxygen pressure. Since oxygen diffuses directly from the atmosphere to the cornea, this fact should be kept in mind.

PRESENT STUDY

Material.—In the present experiment, the temperature was kept constant at within 3 degrees of 73 F.; the atmospheric pressure was varied, and the partial pressure of oxygen was maintained by use of oxygen masks when the atmospheric pressure fell below that comparable to an elevation of 10,000 feet (about 3,000 meters).

Eleven observations were made in a pressure chamber on both eyes of 10 volunteer subjects[2] who were accustomed to using contact lenses. Two of the subjects were females and 8 were males. The ages of 9 subjects ranged from 17 to 33 years; 1, a woman, was 56 years old. One subject had used contact lenses only 2 months; 4 had used them five months; 3, ten to fourteen months, and 2, two years or longer. One could use them with comfort and clear vision for one and a half hours; 2 for three and a half to four hours; 1, for five hours, and 6, for seven to ten hours. One had keratoconus and 2 aphakia. Only 1 subject admitted having noted bubbles under the lens after it was inserted.

Procedure.—Each subject used the solution to which he was accustomed. Each inserted the contact lenses from one half to one hour before the experiment was begun.

Visual acuity was determined by the Snellen chart. The conjunctiva was examined grossly. The fit of the contact lens was noted. The cornea was examined with the slit lamp without removal of the lens. (The lens was removed from one eye in examination of the first 2 subjects; the manipulation of getting the lens out and in again, however, was followed by some conjunctival injection, and it was thought that this might obscure possible subsequent changes.)

The subject and the observer then entered a pressure chamber equipped with a Snellen chart at a distance of 10 feet (3 meters) and with oxygen masks. The atmospheric pressure in the chamber was lowered.[3] The temperature was kept constant. Observations were made at various levels of pressure, the visual acuity and the gross appearance of the conjunctiva, the cornea, the contact lens and the fluid being noted. The subject was not permitted to look at the chart between observations, and various devices, such as having him name the letters in irregular order, were employed to discourage his memorizing the chart. The subject was asked to report any discomfort or blurring of vision. Each "flight" lasted about one hour. At the end of this period, visual acuity was again taken with the Snellen chart, with the subject outside the chamber, and the conjunctiva and cornea were examined with the slit lamp, with the use of fluorescein.

OBSERVATIONS

Observations were made on 22 eyes. The visual acuity of 12 eyes was 10/10 or better; that of 8 eyes, 10/15 to 10/20, and that of 2 eyes, 10/25. In only 1 eye (subject 9) did visual acuity change by more than two or three letters, a variation which is not considered significant. The acuities are, therefore, given only for subject 9.

From the Department of Ophthalmology, Northwestern University Medical School.

This study was undertaken at the request of the Subcommittee on Ophthalmology of the National Research Council.

1. McFarland, R. A.; Evans, J. N., and Halperin, M. H.: Ophthalmic Aspects of Acute Oxygen Deficiency, Arch. Ophth. **26**:886 (Nov.) 1941.

2. The late Dr. Sanford R. Gifford and Dr. Theodore Zekman referred the subjects for study, and Dr. Gifford gave advice in the investigation.

3. Dr. A. C. Ivy, head of the department of physiology, Northwestern University Medical School, gave the use of the pressure chamber, and Dr. Harry F. Adler, of the same department, operated the chamber and offered valuable suggestions in the course of the experiment.

SUBJECT 1.—A man aged 29 had used contact lenses six months. He saw halos after three and a half to four hours.

The minimal pressure was equivalent to that at an elevation of 10,000 feet (about 3,000 meters), attained in thirty minutes. Ten minutes later the subject reported that the eyes felt irritated but that vision was sharper. After the pressure was held thirteen minutes at a level equivalent to that at an elevation of 10,000 feet, it was reduced. No changes were observed in visual acuity, in the appearance of the cornea or conjunctiva or in the fluid in the contact lens.

SUBJECT 2.—A woman aged 56, with aphakia, had used contact lenses over two years; she experienced diminishing vision after wearing them from five to six hours.

A minimal pressure equivalent to that at an elevation of 10,000 feet (about 3,000 meters) was attained in thirty minutes; the "descent" was made at the end of ten minutes. No subjective irritation or change in vision was observed. There was no change in visual acuity, and the cornea, the conjunctiva and the fluid in the contact lens showed no alteration.

SUBJECT 3.—A man aged 29, an Army officer, had used contact lenses six months. He experienced discomfort after wearing them eight hours.

A maximum "elevation" of 10,000 feet (about 3,000 meters) was attained in twenty-five minutes. The subject reported that his vision was better. Ten minutes later he noted "irritation." No change was observed in visual acuity, in the appearance of the cornea or conjunctiva or in the fluid in the contact lens.

SUBJECT 4.—A man aged 33, a business man, made frequent trips by plane; he had used contact lenses for fourteen months, with comfort for periods of ten hours. He had never experienced discomfort or blurring during commercial flights.

A maximum "elevation" of 10,000 feet (about 3,000 meters) was attained in twenty minutes. He reported that his vision was sharper. No change was noted in visual acuity or in the cornea, the conjunctiva or the fluid in the contact lens.

SUBJECT 5.—A man aged 20 had used contact lenses ten months. He stated that he saw halos after wearing the lenses three and a half hours and that occasionally a small bubble formed after the lens had been inserted and worn a while. This may have been evidence of a poor fit. There was a small bubble under the left lens, over the upper part of the cornea, at the start of the "flight."

A pressure equivalent to an elevation of 10,000 feet was attained in nineteen minutes, without changes. Seven minutes later, at a pressure equivalent to an elevation of 18,000 feet (about 5,500 meters), two small bubbles appeared over the upper part of the right cornea and a large and a small bubble over the upper part of the left cornea. At the beginning of the "descent," nine minutes later, the bubbles over the right eye had coalesced, and those over the left eye had not changed. At an "elevation" of 10,000 feet (about 3,000 meters), ten minutes after the "descent" was begun, the bubble on the right side was slightly smaller; the bubbles on the left side were unchanged, and a larger bubble was seen at 2 o'clock on the scleral rim. All the bubbles became smaller as the decrease in pressure continued. No change in visual acuity or in the appearance of the cornea or the conjunctiva was noted.

SUBJECT 6.—A man aged 30 had used contact lenses for five months; he experienced halos and tearing after wearing them one and a half hours. He had never had bubbles under the lens. A pressure equivalent to that at an elevation of 10,000 feet was attained in seven minutes, without changes. A maximum "elevation" of 18,000 feet (about 5,500 meters) was attained in fifteen minutes. A small bubble appeared over the upper part of the right cornea and remained for ten minutes (at a pressure equivalent to that at an elevation of 18,000 feet) and for an additional twenty-five minutes during the "descent" to 7,000 feet (about 2,000 meters), when the bubble appeared smaller. The bubble had disappeared by the time the ground level pressure was reached, at the end of another fifteen minutes. No changes were noted in visual acuity or in the appearance of the cornea or the conjunctiva.

SUBJECT 7.—A man aged 23, with bilateral keratoconus, had used contact lenses six years; he wore them seven hours with comfort.

A minimal pressure equivalent to that at an elevation of 20,000 feet (about 6,000 meters) was attained in twelve minutes. The decrease in pressure was begun in twelve minutes. No bubbles were noted under the lens, and there was no change in the cornea or the conjunctiva.

SUBJECT 8.—A woman aged 28 had used contact lenses eleven months. She wore them with comfort and clear vision for five or six hours, without development of bubbles.

A maximum "elevation" of 20,000 feet (about 6,000 meters) was attained in twenty-five minutes. No change in visual acuity or in the cornea or conjunctiva was noted, and no bubbles appeared in the fluid of the contact lens.

SUBJECT 9.—A man aged 22, with aphakia, had used contact lenses six months. He wore the lenses four hours with comfort, then changed the fluid and reinserted the lens, this process being repeated every four hours. Bubbles did not develop. Visual acuity with the contact lens was 10/15 in the right eye and 10/20 in the left eye at the start of the "flight."

At a pressure equivalent to that at an elevation of 25,000 feet (about 7,500 meters), which was reached in twenty minutes, visual acuity was 10/20 in both eyes. A pressure equivalent to that at an elevation of 30,000 feet (about 9,000 meters) was reached five minutes later. Several bubbles appeared over the left pupil only after the pressure had remained fifteen minutes at the 30,000 foot level. Although there was no demonstrable decrease in visual acuity, the subject saw a blur before the left eye. The bubbles did not disappear despite a slow decrease in pressure and a pause at the 20,000 foot (about the 6,000 meter) level. No change was noted in the cornea or the conjunctiva.

SUBJECT 10.—A youth aged 17, who had recently been rejected by the Air Corps, obtained contact lenses two months before coming under observation, with the hope of being admitted to this service. He wore contact lenses comfortably and with good vision seven to eight hours a day, and bubbles did not develop.

A pressure equivalent to that at an elevation of 20,000 feet (about 6,000 meters) was attained in fifteen minutes. There were six minute bubbles in a cluster over the upper part of each cornea. At 25,000 feet (about 7,500 meters), five minutes later, seven or eight small bubbles were noted over the upper portion of the right cornea and nine bubbles over the upper half of the left cornea. Visual acuity was 10/10 (no letters smaller than "10 foot size" were available). Bubbles became more numerous in the next fifteen minutes, at an "elevation" of 30,000 feet (about 9,000 meters),

and extended over the pupillary area. After the "descent" to a pressure equal to that at 20,000 feet (about 6,000 meters) in five minutes, at which level it remained for five minutes, the bubbles did not disappear. Five minutes after the ground level pressure was reached, one small bubble remained under the left lens.

The subject stated voluntarily: "The bubbles obscured vision; I could move them by blinking but if I had to shoot I'd probably miss—I could not take the time."

SUBJECT 7.—At a pressure equivalent to that at an elevation between 20,000 and 25,000 feet (about 6,000 and 7,500 meters), which was reached in twenty minutes, bubbles developed over the upper part of the right cornea. The pressure was increased to the 30,000 foot level and held there fifteen minutes. No bubbles developed under the left lens. The bubbles under the right lens showed no change after the subject had remained at the 20,000 foot level for five minutes, during the "descent." The bubbles did not enter the pupillary area and were not noticed in any way. One bubble remained ten minutes after the ground level pressure was reached. There was no change in the visual acuity or in the appearance of the cornea or conjunctiva.

SUMMARY

1. Four persons subjected to a pressure equivalent to that at an elevation of 10,000 feet (about 3,000 meters) showed no signs or symptoms.

2. Of 4 subjects subjected to a pressure equivalent to that at an elevation of 18,000 to 20,000 feet (about 5,400 to 6,000 meters), 2 had bubbles under the lenses, 1 in one eye and the other in both eyes.

3. Of 3 subjects subjected to a pressure equivalent to that at 30,000 feet (about 9,000 meters), 2 had bubbles under one lens. The third subject had bubbles under both lenses, 1 at the 20,000 and the other at the 25,000 foot (6,000 and 7,500 meter) level.

4. Of 6 persons[4] who were subjected to a pressure equivalent to that at an elevation of 18,000 feet (about 5,400 meters) or over, 5 had bubbles under at least one lens.

5. The presence of bubbles was not always associated with demonstrably lowered visual acuity. (This may have been due to the limitations placed on the method of determination of the visual acuity by the small chamber.) The subject was sometimes aware of clouding of vision, even though he might read as many letters on the Snellen chart as before the flight.

6. One of the subjects who had bubbles under the lens at high pressures could wear his lenses during ordinary activities only one and a half hours; 2 subjects wore them three and a half to four hours, and 2 subjects wore them seven to eight hours. One subject, who wore contact lenses five to six hours, had no signs or symptoms at a pressure equivalent to that at 20,000 feet (about 6,000 meters). Another subject, who wore the lenses seven hours, did not have bubbles at the 20,000 foot level in his first "flight," but had them at the 25,000 foot (6,000 meter) level in his second "flight."

7. No change in the cornea or the conjunctiva was observed.

CONCLUSIONS

The length of time the contact lenses can be worn (which may be a criterion of a good fit) was not shown to be related to the formation of bubbles.

Although the number of subjects was small, the results were rather consistent. Habitual wearers of contact lenses when subjected to pressures equivalent to those at elevations of 18,000 feet (5,400 meters) or above may be expected to have bubbles under the lenses, which will, in all probability, cause diminution of vision. This is not to be construed as a contraindication to the use of contact lenses at ordinary altitudes.

121 Irvington Avenue.

4. Subject 7 was in both the 18,000 to 20,000 foot (5,400 to 6,000 meter) and the 30,000 foot (9,000 meter) group.

STAPHYLOCOCCIC THROMBOPHLEBITIS OF THE CAVERNOUS SINUS

REPORT OF A CASE, WITH RECOVERY WITH CHEMOTHERAPY AND HEPARIN

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NEPTUNE, N. J.

Prior to the use of sulfanilamide and its derivatives, infectious thrombosis of the cavernous sinus was usually fatal. MacNeal, Frisbee and Blevins [1] recently collected 58 cases in which the patients recovered. In 17 of these cases the thrombosis was of staphylococcic origin. In 4 cases recovery followed expectant treatment; in 2 cases, prophylactic surgical measures; in 1 case, early radical operation; in 4 cases, bacteriophage therapy, and in 1 case, the use of antitoxin, while in the remaining 5 cases cure was obtained with various sulfonamide compounds. In a later report [2] the same authors published the results in 45 cases of thrombosis of the cavernous sinus of staphylococcic origin in which only bacteriophage therapy was given. In 14 cases the patients survived; in 23 cases they died within five days, and in 8 cases they died after a prolonged illness.

In 1941 Schall [3] reported 3 cases in which treatment with sulfonamide compounds and heparin was successful. He used sulfapyridine, sulfathiazole and 225,000 units of heparin in his first case, the first two drugs and 580,000 units of heparin in his second case and sulfathiazole and 130,000 units of heparin in his third case, 1,000 units of the heparin solution being equivalent to 10 mg. of heparin. He stated that sulfadiazine might prove later to be the drug of choice in similar cases.

Also, Ershler and Blaisdell [4] reported a case in which recovery followed the use of 106 Gm. of sulfathiazole and 129,500 units of heparin. This case was complicated by massive hematuria, so that ten transfusions (3,250 cc. of whole blood) were required to offset the severe secondary anemia which developed. The hematuria was attributed to the heparin because as soon as its use was discontinued the hematuria ceased.

Because the use of sulfonamide compounds has notably reduced the death rate from severe staphylococcic infections and because the recent use of heparin seems to be of theoretic and practical value in prevention of the spread of septic emboli, in stabilization of a clot and in prevention of further thrombosis, it was thought worth while to report a case of particularly severe staphylococcic thrombosis of the cavernous sinus in which treatment with heparin and the sulfonamide compounds was successful.

REPORT OF CASE

T. N., an Italian woman aged 20 years, picked a pimple on the left side of her forehead on Sept. 10, 1942. Later in the day she complained of pain and discomfort in her head and left eye. On September 11 pain was still present, and both lower eyelids were swollen and "flushed," particularly the left. She was admitted to the Utica General Hospital on this date.

On admission the oral temperature was 105.4 F., the pulse rate 142 and the respiratory rate 24. A small furuncle was present on the left side of the forehead. There was pronounced edema of the lids of the left eye and of the upper lid of the right eye, with chemosis of the inferior bulbar portion of the conjunctiva of the left eye. The veins of the nose were congested. The face was slightly edematous. The ears were normal. The Kernig and Brudzinski signs were elicited, and ankle clonus was present. A roentgenogram of the nasal sinuses was negative for sinusitis, nor was there any clinical evidence of such a condition. The patient was acutely ill.

The ocular changes became progressively worse. Within forty-eight hours both eyes showed severe proptosis, edema of the lids and chemosis. Lumbar puncture, done on September 13, revealed 2,206 cells in the spinal fluid (mostly polymorphonuclear leukocytes) per cubic millimeter. Staphylococcus aureus was grown from cultures of the spinal fluid. On September 14 a diagnosis of thrombosis of the cavernous sinus was made. On this date a blood count showed 22,800 leukocytes, with 88 per cent polymorphonuclear neutrophils.

Intensive treatment against the infection was then instituted. Sulfathiazole, previously given by mouth, was also administered intravenously in amounts so that the concentration in the blood reached 20 mg. per hundred cubic centimeters. Also, large doses of sulfadiazine were given by mouth because this drug is said

1. MacNeal, W. J.; Frisbee, F. C., and Blevins, A.: Thrombophlebitis of the Cavernous Sinus, Arch. Ophth. **29**:231 (Feb.) 1943.

2. MacNeal, W. J.; Frisbee, F. C., and Blevins, A.: Bacteriophage Therapy of Staphylococcic Septic Obstruction of the Cavernous Sinus, Arch. Ophth. **29**:341 (March) 1943.

3. Schall, L. A.: Treatment of Septic Thrombophlebitis of the Cavernous Sinus, J. A. M. A. **117**:581 (Aug. 23) 1941.

4. Ershler, I. L., and Blaisdell, I. H.: Massive Hematuria Following the Use of Heparin in Cavernous Sinus Thrombosis, J. A. M. A. **117**:927 (Sept. 13) 1941.

to enter the spinal fluid in concentrations up to 65 per cent of that in the blood.

To prevent further thrombosis, heparin solution was given in doses of 10 cc. (10 mg., or 1,000 units, of heparin), diluted in 750 cc. of isotonic solution of sodium chloride U. S. P. A total of 45 cc. (45,000 units) was given during the first month of hospitalization. The coagulation time of the blood was increased to fifty-five minutes.

The patient received 150.5 Gm. of sulfathiazole during a period of five weeks and 498 Gm. of sulfadiazine during a period of four months.

The eyes, which were conspicuously proptosed and immobile, received almost continuous treatment with boric acid compresses. Boric acid ointment and ointment containing butacaine sulfate, 2 per cent, and metaphen, 1:3,000, were used to protect the corneas and to combat pain. Several times a day the lids were pulled down over the corneas and held in place with adhesive tape and eye patches.

Photographs of the patient. *A*, during the third week of her illness. The severe proptosis and edema of the lids are evident. The left eye is involved more than the right. *B*, during the fifth week of her illness. The palsy of the left side of the face is apparent. *C*, during the tenth week of her illness. The right eye is nearly normal. The left eye is still proptosed, and the lids are edematous. Only a trace of the palsy remains on the left side of the face. The patient's general nutritional condition has improved (compare with *B*).

Transitory paralysis of the left facial nerve occurred during the fifth week. This gradually cleared up. The temperature fluctuated between 100 and 104 F. for eight weeks. During the eleventh week it fell to 99 F., after which time it was essentially normal.

The proptosis and chemosis of the right eyeball and the edema of the lids of the right eye slowly decreased, and the ocular movements improved so that this eye and its adnexa were essentially normal after the tenth week. In the left eye there developed a superficial opacity of the cornea, due to exposure. Some proptosis and chemosis and pronounced limitation of motion were still present when the patient left the hospital, on Feb. 27, 1943.

At no time was there edema of either disk. The fields were always normal in confrontation tests.

Owing to the prolonged fever, the patient became rather emaciated. Supportive therapy included intravenous injections of dextrose, the use of the Levine tube for introduction of milk, broth and fruit juices into the stomach and administration of aminoacetic acid, vitamins and iron, copper and liver products. She was discharged on February 27, in relatively good physical condition, after a sojourn in the hospital of more than twenty-four weeks.

On March 2, the results of ophthalmologic examination (Dr. Walter F. Duggan) were as follows: Vision in the right eye was 20/15; in the left eye it was 20/200 without correction, 20/160 with + 1.00 D. cylinder, axis 180 and 20/120 with a stenopeic aperture. The right eye was normal, both internally and externally, except for a trace of chemosis at the inner canthus. The pupil measured 3 mm. and reacted directly and consensually to light. The palpebral fissure measured 6 mm.; with a maximal effort to open the eye it measured 12 mm. The extraocular muscles were normal. The left eye was moderately proptosed. A long horizontal fold of chemotic conjunctiva lay just below the cornea. In the cornea were two superficial horizontal opacities, one of which extended across the center of the pupil and was the cause of the lowered visual acuity of this eye. The pupil was 6 mm. in diameter and did not react either directly or consensually to light. The disk and the retinal vessels were normal. As a result of ptosis on this side the palpebral fissure measured 2 mm.; with a maximal effort to open the eye it measured 8 mm. The patient could abduct the left eye 35 degrees and adduct it 20 degrees. The vertically acting rectus muscles and the inferior oblique muscle were completely paralyzed. The superior oblique muscle showed a trace of function.

CONCLUSIONS

In a case of staphylococcic thrombophlebitis of the cavernous sinus treatment was successful with sulfathiazole, sulfadiazine and heparin.

As compared with the amount of heparin given in 4 other cases, only a small amount (45,000 units) was used in the case reported.

It will be neceasary to give heparin in a larger number of cases before its value can be determined. Theoretically, its use is indicated in cases of this condition.

1301 Corlies Avenue.

INFECTION OF LYMPHOID TISSUE OF THE PHARYNX AND OF THE CONJUNCTIVA

RICHARD WALDAPFEL, M.D.
GRAND JUNCTION, COLO.

The anatomic structure of the pharyngeal mucous membrane is characterized by the ample occurrence of lymphocytic elements. They appear singly or in aggregations and in certain nodular formations, which are called lymph follicles. Regular arrangements of such follicles are called tonsils. No matter whether they represent real tonsils or other aggregations of lymphoid tissue, they are homogeneous formations with identical histologic structures, in their entirety called the lymphoid apparatus of the pharynx, and they act alike both in anatomic and in pathologic respects. The acute inflammation of this lymphoid apparatus is called tonsillitis, or angina, the latter name being more comprehensive than the former.

The same kind of lymphoid tissue is present in the conjunctiva of the eye. It appears after the third month of life and is rather thin, in accordance with the minor thickness of the conjunctiva, forming a superficial adenoid layer over the conjunctiva and showing its main formation in the fornix of the conjunctiva.

On the basis of the anatomic analogy between the lymphoid structure in the pharynx and that in the conjunctiva, it was obvious to expect an analogy between the infections involving the lymphoid tissues in the two regions. Two previous reports [1] have confirmed this opinion, with verification by microscopic observation in 1 case. The simultaneous occurrence of infections in the two organs would prove most definitely the analogous character of the infections. I could not find an instance of such an occurrence in the literature available. The 2 cases here reported appear, therefore, of special significance.

REPORT OF CASES

CASE 1.—Mrs. H. L. W., aged 36, complained of soreness and "mattering" in the right eye during the preceding two days. The disturbance started simultaneously with a sore throat, and she still had some difficulty in swallowing and in general was not feeling well.

Eyes.—Examination showed that the left eye was normal. The right eye (figure, *A*) had a mucopurulent discharge; the caruncle was reddened and somewhat enlarged, and the adjacent portion of the conjunctiva of the fornix had the appearance of a thick, infiltrated, spindle-shaped cord, most conspicuous in the nasal portion of the fornix. Very small yellowish points, representing minute infected subepithelial lymph follicles, were shining through the epithelium. The vessels of this part of the conjunctiva were slightly dilated. The rest of the bulbar conjunctiva and the palpebral conjunctiva of the lower lid showed less injection; the conjunctiva of the upper lid appeared fairly normal. The cornea and the remaining sections of the eye were without noticeable pathologic changes. The temperature was 100 F.

Pharynx.—The tonsils were small; the pillars were reddened, and the crypts contained yellowish plugs. Back of each tonsil a longitudinal, dark red swelling of the pharyngeal mucous membrane, with yellowish spots, was visible. These spots were infected subepithelial lymph follicles within bilateral longitudinal aggregations of lymphoid tissue in the posterior pharyngeal wall, known as lateral lymphoid cords of the pharynx, which were infected in the same way as the pharyngeal tonsils.

Diagnosis.—The diagnosis was pharyngeal tonsillitis and infection of the lateral lymphoid cords of the pharynx. *D* of the figure is a photograph of the right half of the throat, showing the infiltrated lymphoid tissue (dark) and numerous infected lymph follicles, appearing as white spots in the darker area.

Course.—Sulfadiazine was given internally, and sulfathiazole ointment was applied locally to the conjunctival sac; within two days both the pharyngeal and the ocular condition had returned to normal.

CASE 2.—W. E. S., a man aged 54, stated that his right eye had been sore and swollen for the past three days. The ocular trouble started at about the same time as did a sore throat. He was feeling sick in general. A similar trouble had occurred in the same eye three years before.

Eyes.—The left eye was normal. The upper lid of the right eye (figure, *C*) was edematous. The conjunctiva of the upper lid and of the bulb was injected, and the temporal portion of the fornix was swollen. In the temporal half of the palpebral conjunctiva of the upper lid two yellowish spots were visible. These yellowish spots were subepithelial abscesses of the lymph follicles, which have previously been described,[1a] and belonged to the conjunctiva, with which they could be moved. Each yellow spot was surrounded by a slightly inflamed halo. Some mucopurulent discharge was present.

Pharynx (figure, *B*).—The tonsils had been removed years before. A small tonsillar tag had been left in the upper portion of the right tonsillar fossa. On the tag, which was swollen, three yellow subepithelial spots could be seen, each one surrounded by a narrow inflamed zone. Below them, in the lymphoid tissue of

1. Waldapfel, R.: Abscess-Forming Follicular Conjunctivitis, Arch. Ophth. **27**:929 (May) 1942. Rigg, J. P., and Waldapfel, R.: Acute Abscess of the Lymph Follicles of the Conjunctiva, ibid. **22**:882 (Nov.) 1939.

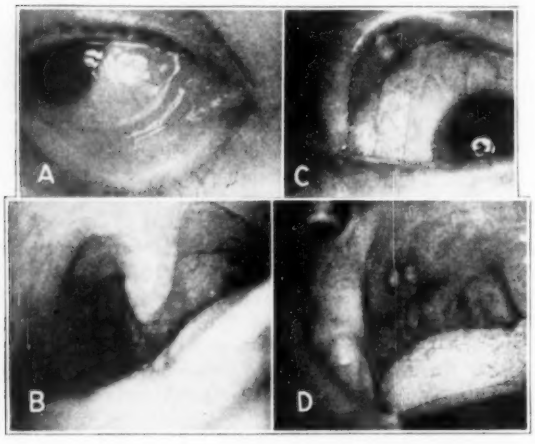
the posterior pharyngeal wall, were several spots which were considerably smaller but otherwise of the same appearance. All were strictly limited to the lymphoid tissue of the pharynx and represented miliary abscesses within the lymph follicles, as was described previously.[2]

Course.—The temperature was 100.2 F. Sulfadiazine, administered internally, and sulfathiazole ointment, instilled into the right eye, restored the condition of the eye and the pharynx to normal within two days.

COMMENT

The 2 cases had in common simultaneous infections of the lymphoid tissue of the conjunctiva and of the pharynx. The clinical pictures left no doubt of the relation of the pathologic changes in the two areas and of the identical pathogenesis of the conjunctival and the pharyngeal process.

This infection of the conjunctiva, which corresponds to tonsillitis, or angina, of the pharynx, might justly be named angina of the conjunctiva



A (case 1), infiltration of the lower fornix of the conjunctiva of the right eye, with a few minute infected lymph follicles; *D* (case 1), infiltration of the right side of the pharyngeal mucous membrane, which appears dark, with numerous infected subepithelial lymph follicles; *C* (case 2), two abscessed subepithelial lymph follicles within the palpebral conjunctiva of the upper lid of the right eye, and *B* (case 2), three abscessed subepithelial lymph follicles within a tonsillar tag in the right side of the throat and in several small ones within the lymphoid tissue of the posterior pharyngeal wall on the same side.

These photographs are black and white prints from kodachrome transparencies.

if the name "angina," since ancient times, had not been reserved for changes in the throat accompanied by signs of obstruction. In a previous report,[1a] therefore, I suggested the name "abscess-forming follicular conjunctivitis" for this type of conjunctival infection, on the basis of its microscopic picture, which is characterized by the occurrence of miliary abscesses in the lymph follicles of the conjunctiva, analogous to the abscesses in the lymph follicles of the pharynx associated with acute tonsillitis.

This acute infection of the conjunctiva, according to the foregoing reports, is a disease entity which may appear clinically in the eye associated with the following symptoms: (1) diffuse swelling of the fornix and (2) yellowish spots, representing abscessed follicles, single or multiple, in the conjunctiva of the palpebra or of the bulb, surrounded by an inflamed halo and covered with epithelium. With both a variable amount of discharge, injection of the conjunctiva, chemosis, edema of the lids and photophobia are present.

In view of these observations, attention to the eyes may be indicated in cases of acute infection of the lymphoid tissue of the pharynx and vice versa. It is not at all improbable that a number of cases of conjunctivitis accompanying infection of the pharynx may prove to be coordinated infections with the same cause.

This discussion is likely to revive an old hypothesis. In the years following World War I controversies on the "tonsil problem" were much in vogue in Europe. In those days, Johannes Fein, an Austrian army surgeon, proposed the theory that tonsillitis was not an isolated, local disease of the tonsils but a partial symptom of a systemic infection of the lymphoid tissue of the whole body, and the pharyngeal tonsils presented merely the first apparent local manifestation of this general infection.[3] The tonsillitis, according to this theory, was not the basic disease but the secondary localization of an infection which had taken place elsewhere; in the same way, rheumatism, nephritis and appendicitis were all, like tonsillitis, equivalent, coordinated symptoms of the same infection, and not the after-effects of the tonsillitis. In further consequence of this hypothesis, and to designate the general and systemic character of the disease, he suggested the name "anginosis" instead of angina or tonsillitis, which names designate the pathologic process as a local infection of the tonsils.

This theory experiences in the present report a new confirmation from the ophthalmologic side. Simultaneous infection of the pharyngeal and of the conjunctival lymphoid tissue furnishes evidence of the common etiologic factors and the identity of the infection in the two areas. The pathologic process in the pharynx and that in the conjunctiva appear as equivalent, coordinated manifestations of one infection.

The cases here reported are therefore significant for two reasons: 1. They present an infection of the conjunctiva which is analogous to and identical with the infection of the lymphoid tissue

2. Grossmann, B., and Waldapfel, R.: Lacunar Tonsillitis, Acta oto-laryng. **10**:1, 1925.

3. Fein, J.: Die Anginose, Berlin, Urban & Schwarzenberg, 1921.

of the pharynx in tonsillitis. 2. They support the theory that tonsillitis is only part of a general infection of the lymphoid system, rather than a localized infection of the tonsils.

The treatment takes advantage of this knowledge. Both the significant features of the cases just noted point to the existence of a general infection and, therefore, to the use of drugs for general treatment, rather than to the local application of remedies supposed to have a germicidal effect, and used for such action in the past. In fact, Fein demanded, many years ago, that the local treatment of tonsillitis be neglected in favor of the general, internal therapy. The pharmacologist of those days, searching for potent drugs for this purpose, used salicylates, methenamine or mercuric cyanide. Research of recent years has considerably improved the medication. This infection, being of streptococcic origin in the majority of cases,[2] responds favorably, and almost selectively, to the internal use of sulfonamide compounds, so that treatment with these substances seems to be the method of choice. Local therapy may be helpful by producing a mild, useful hyperemia of the diseased parts.

SUMMARY

In the 2 cases reported here infection of the conjunctiva occurred simultaneously with an analogous infection of the pharynx, and both conditions proved to be infections of the lymphoid tissue of identical origin. It appears that there exists a conjunctivitis which is the equivalent of tonsillitis and that some infections of the conjunctiva which accompany infections of the pharynx are to be regarded as coordinate and of the same origin.

De Merschman Gardens.

Clinical Notes

MODIFICATIONS OF THE TONOMETER

JOHN N. EVANS, M.D., BROOKLYN

The general dissatisfaction with the tonometer as a dependable clinical instrument is being voiced with increasing frequency. Its continued employment is justified in that the only other method of estimating pressure, digital palpation, gives results even less accurate and less interpretable.

In 1929-1930 I had occasion to examine for mechanical defects about 100 tonometers of various makes. The great majority of these instruments showed such grave imperfections as to render them well nigh worthless as diagnostic aids. No report of this study was made because the data were too incomplete and the investigation was supplementary to a larger problem, that of "optical tonometry." On careful considera-

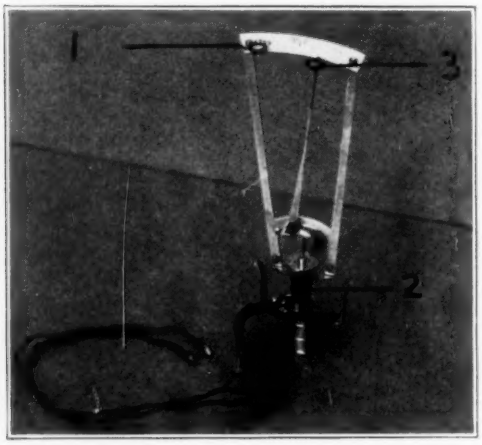


Fig. 1.—*1*, weak plus lens, focusing light from the ophthalmoscope bulb (*2*) on the ceiling as a zero reference point; *2*, ophthalmoscope bulb attached to the finger grip of the tonometer, wires from which connect with a dry cell, clipped on the examiner's wrist; *3*, weak plus lens attached to the pointed focusing light from ophthalmoscope bulb (*2*) on a scale projected on the ceiling.

tion of the subject, it is obvious that a purely optical means of studying intraocular pressure is highly desirable. No mechanical contact should exist between the eye and the recording device, as the irritation of any foreign substance probably modifies the balance of ocular pressure.

In the course of protracted studies of this problem, certain modifications of the standard tonometer have been evolved which may in themselves be worth consideration.

In an effort to magnify the standard readings with the Schiøtz tonometer, the instrument shown in figure 1 was evolved. A weak plus lens was attached to the scale and a similar plus lens to the tip of the pointer. An ophthalmoscope bulb was attached to the finger grip as illustrated so that its emitted light impinged on both lenses, irrespective of their relation to each other. An appropriate scale was projected on the ceiling of the room so that it was directly above the tonometer as it was applied to the eye of the reclining subject. A bright point of light was thus projected on this scale by concentration of

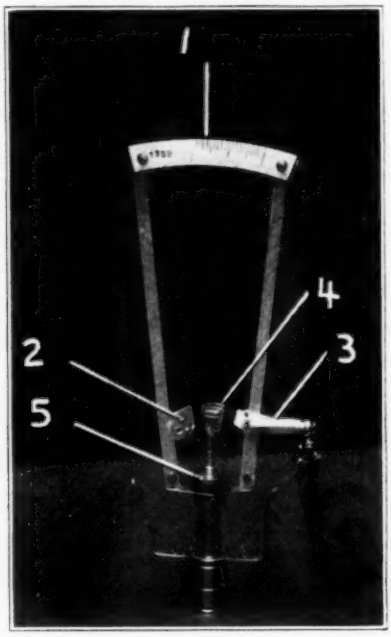


Fig. 2.—*1*, tonometer scale, with attached accessory weights to help in compensating for the pointer, pivot and cam, which have been removed; *2*, counterweight to balance ophthalmoscope bulb (*3*); *3*, ophthalmoscope bulb, projecting light horizontally through the right angle prism–cylindric lens combination (*4*); *4*, right angle prism–cylindric lens combination, which deviates light from the ophthalmoscope bulb and focuses it as a sharp line on the tonometer scale (*1*); *5*, modified tonometer weight to compensate for added prism lens (*4*). Wires from the ophthalmoscope bulb are connected to a single dry cell, mounted by a clip on the wrist of the examiner.

the light of the ophthalmoscope lamp by the lenses on the tonometer scale and pointer. The projected scale was adjusted until it corresponded

to the stationary point of light. The spot of light projected by the lens on the needle then recorded the movements of the needle with great magnification. Ocular pulsations were thus easily studied. Modifications in the weight of the tonometer were made so that the final instrument was equivalent in weight to the original one.

SECOND MODIFICATION

Another series of changes resulted in the elimination of three moving parts which were the most common source of mechanical defects in the instruments examined. By removal of the pointer, its pivot and the sliding cam against which the tonometer rod operated, a tonometer with only one moving part was obtained.

In order to record the rise and fall of this rod, a prism-lens combination was mounted on the rod in such a way that light from the attached ophthalmoscope bulb, in striking the face of the prism, was deviated vertically and focused on the scale by a cylindric lens mounted on the upper surface of the prism. This arrangement resulted in a pencil of light which acted as a recording needle, with the prism-lens as a fulcrum. It thus recorded the readings on the scale in the usual manner. It was necessary to make allowances in weight for the loss of the lever, pivot and cam and to make other allowances for the weight of the added prism-lens combination; it was also necessary to rebalance the instrument in order to redistribute the shift of weight with the addition of the ophthalmoscope bulb.

In each instrument a small battery attached to the examiner's wrist by a spring clip supplied the current through a delicate flexible cable.

Other models of the tonometer with but one moving part are in the course of development.

It seems fair to assume that certain mechanical defects in standard tonometers have been eliminated in this instrument.

23 Schermerhorn Street.

AXIS FINDER CHART

CAPTAIN PHILIP L. MASOR, MEDICAL CORPS, ARMY OF THE UNITED STATES

Ophthalmologists have long sought for objective methods of refraction, since the results are reliable and will therefore give the greatest percentage of relief. To further this end, the axis chart which I used in the course of refraction with streak retinoscopy is presented; use of this chart appreciably shortens the examination, at no expense to precision. For patients of all ages, cycloplegic refraction is the most reliable and is the method of choice, and neutralization by plus and minus spheres is the common method.

Fig. 1.—Streak retinoscope (Copeland).

I use the method of electric streak retinoscopy (Copeland), which is not as popular as plano-mirror retinoscopy but which has been found to be scientific, reliable and convenient. A few words will describe the simple construction of the streak retinoscope (Copeland).

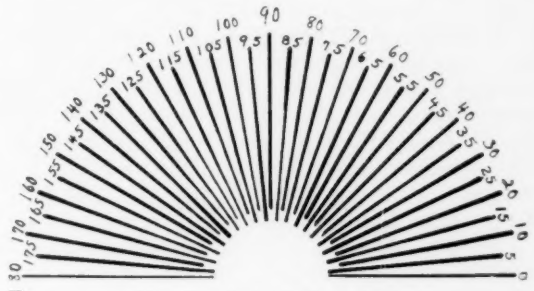


Fig. 2.—Axis finder chart.

STREAK RETINOSCOPY

The streak of light is produced by the specially constructed filament, which is designated in the shape of a hairpin or an inverted, broadly arched U. The condensing lens projects the transverse portion of this filament and produces the image of a straight line. The knurled sliding sleeve on the handle of the instrument varies the width of this streak, and the sleeve may be rotated through 180 degrees, with rotation of the streak.

The refractive error is neutralized with plus or minus spheres. The meridian of least refraction (the smaller error) is neutralized first by plus or minus spheres,

and then the meridian of greater refraction. The position of the streak neutralizing the greater error determines the axis of the cylinder. At this stage the latter streak (the neutralizing streak of the greater refractive error) is projected on a chart marked in degrees, which is located on the wall above the head of the patient. The axis is determined within 3 degrees. The objective method of retinoscopy in general is highly favored. The axis thus found by projection is also purely objective and does not in any way depend on the opinion or fancy of the patient.

Each ophthalmologist can prepare his own chart for finding the axis. I suggest a chart drawn on white cardboard 16 by 10 inches (40.6 by 25.4 cm.). The meridians of half an arc are drawn and lined every 5 degrees. The lines should be distinct enough to be seen by the refractionist in a darkened room at a distance of 1 meter. The designations of the meridians should also be readily discernible.

Determination of the axis with use of the chart is reliable and convenient. By virtue of its objectiveness and ease of operation, the time of examination is greatly reduced, as well as labor saved. In the beginning, streak retinoscopy and objective determination of the axis seem difficult, but after a few months of practice, ease of operation and precision are obtained.

It is a recognized procedure that cylinders are also used in conjunction with spheres in determination of the axis. It is not my intention to decry the use of cylinders; rather, I wish to emphasize that, in addition to accuracy, speed is essential in the examination of the thousands of men subjected to refraction on short notice, and who are often quickly moved from one military station to another.

SUMMARY

The axis chart presented here is used to determine the axis of a cylinder in streak retinoscopy (Copeland) when only spheres are used. It is found to be convenient, reliable and labor saving and appreciably shortens the time required for refraction.

IRITIS, RETINAL HEMORRHAGE AND CHANGES IN THE LENS FOLLOWING INJECTION OF TYPHUS VACCINE

Report of a Case

MAJOR EDWARD F. EAGAN AND CAPTAIN HAROLD J. HALPERN,
MEDICAL CORPS, ARMY OF THE UNITED STATES

Ocular manifestations following injections of serum have not been common, although cases have been reported. Mason [1] reported 3 cases in which measurable blurring of the optic disks developed during serum sickness, with gradual return to normal. Brown [2] reported 5 cases in which elevation of the disk and edema of the retina developed after administration of diphtheria antitoxin. These signs subsided in a few days. Bedell [3] described severe and extensive bilateral edema of the retina with superficial hemorrhages, which he attributed to serum sickness following the injection of tetanus antitoxin. This condition cleared up rapidly, leaving few vestiges. Theodore and Lewson [4] reported 1 case of iritis following antipneumococcic serum.

The case reported here is unusual because it involved damage to the iris, lens, optic nerve and retina without any serum sickness or other prodromal symptoms.

A white soldier aged 22 walked into the ophthalmic clinic complaining of poor vision in the right eye of one week's duration.

The history revealed that he had never had any ocular trouble or systemic disease. He had been in the Army twenty-two months and had had the usual injections of tetanus antitoxin and typhoid vaccine, about four days after induction, to which there had been no untoward reaction. Vision at the time of enlistment was 20/20 in each eye. He had had no previous trouble during training. One week before his admission to the clinic he received his first injection of typhus vaccine, 1 cc., routine before overseas duty. Thirty-six hours later he noticed that his right eye was red and painful. He reported to the ophthalmic clinic of his hospital, where a diagnosis of iritis was made. He stated that vision was blurred at the onset.

Treatment consisted of hot compresses and dilation of the pupil with atropine. The redness and pain subsided, and he was shipped to Camp Kilmer, N. J. He reported to the ophthalmic clinic one week later, complaining that his vision was practically gone.

Examination.—The right eye had no light perception; vision in the left eye was 20/30 + 2, with no apparent refractive error or pathologic process as an etiologic factor. The left eye was normal throughout. The eyelids, cornea and conjunctiva of the right eye were normal; ocular tension was 18 mm. in the right eye and 19 mm. in the left eye. The pupil was dilated and did not respond. The iris was bound down to the lens at 12, 5 and 8 o'clock. The lens showed many small deposits of iris pigment on the anterior surface.

The vitreous was cloudy. Examination of the fundus, which was seen with difficulty, revealed only two or three vessels. The disk was not seen clearly, but over the area of the disk was a large, whitish patch, resembling exudate, which extended temporarily to cover the macular area. Because of the hazy vitreous no other details could be made out.

1. Mason, V. R.: Optic Neuritis in Serum Sickness, J. A. M. A. **78**:88-89 (Jan. 14) 1922.

2. Brown, A. L.: Ocular Manifestations in Serum Sickness, Am. J. Ophth. **8**:614-618 (Aug.) 1925.

3. Bedell, A. J.: Stereoscopic Fundus Photography, J. A. M. A. **105**:1502-1509 (Nov. 9) 1935.

4. Theodore, F. H., and Lewson, A. C.: Bilateral Iritis Complicating Serum Sickness, Arch. Ophth. **21**: 828-832 (May) 1939.

The patient was admitted to the hospital and put to bed. A complete medical examination revealed no systemic disease. Laboratory tests, including the Kahn test, chemical studies of the blood and tuberculin tests gave normal results. Examinations of the teeth, ears, nose and throat showed no evidence of any foci of infection. The neurologic examination was negative.

The patient was reexamined five days later, when beginning opacity of the lens was also present. Many whitish interweaving streaks were observed in the anterior portion of the lens.

The patient's condition showed no improvement at the end of three weeks, and he was discharged from the service, with instructions to have follow-up examinations at his nearest veterans hospital.

SUMMARY

This case of iritis, retinal hemorrhage and lenticular changes following injection of typhus vaccine appears to be unique, as no similar case can be found in the literature. Although no follow-up observation was made in this case, there is no question that the extensive permanent damage in the retina will result in loss of vision in that eye.

Correspondence

OCULAR OCCLUDERS

To the Editor:—In the February 1944 issue of the ARCHIVES, page 170, Dr. Joseph I. Pascal, in correspondence on a recent article on monocular occlusion from the Dartmouth Eye Institute, writes that "The real purpose of occlusion . . . is to prevent binocular fixation of the object of attention." We believe this is only partly true.

Dr. Pascal has fallen into the same error that many others have when he thinks that partial occlusion is sufficient for a diagnostic or a therapeutic test. In fact, opinions expressed by members [1] of the staff of the Dartmouth Institute in the past have shown that they, too, at one time held the same belief. In our paper [2] on monocular occlusion we point out that reliable and consistent results were obtained only by complete occlusion of one eye, and it is this fact that we wish to stress.

Lancaster never attached any diagnostic importance to the fact that a patient reported no relief when only partial occlusion had been employed. He emphasized the importance of occluding both the central and the peripheral field of one eye in the monocular occlusion test in order to interrupt completely all the phases of binocular vision. Burian [3] demonstrated that peripheral visual stimuli play a large part in binocular vision—so much so that central fixation is disturbed if the peripheral stimuli are sufficiently large and intense.

Many of our patients reported that the least bit of light coming into the occluded eye caused discomfort, whereas with more complete occlusion they were quite comfortable. Dr. Lancaster used monocular occlusion two or three times for therapeutic reasons to once for diagnostic purposes. One of his patients, for whom he prescribed an opaque contact lens for one eye, reported having complete comfort for several months, but returned when headaches began to recur. It was found that a small peripheral piece of the enamel, used to make the contact lens opaque, had been chipped off, so that light could enter the eye. When the enamel was replaced and the lens again made completely opaque, the patient's symptoms were relieved.

Dr. Pascal is quite right when he says that an inconspicuous occluder is an advantage. Certainly, this should be of no great concern when the complete occluder is to be used for diagnostic purposes, and is to be worn for only two weeks. Other things being equal, the less conspicuous the occluder, the better, but to sacrifice the purpose of occlusion for the sake of appearance is advocated only by those who are not aware of the fact that they are making such a sacrifice.

Partial occlusion results in many failures in diagnostic as well as therapeutic use, and, what is more important, it often gives misleading information. An occluder which will interrupt binocular coordination as completely as possible is by far the best for the purpose of predicting whether or not a patient's symptoms are due to a binocular anomaly. In many cases a complete occluder is the only means of obtaining continued relief from an uncorrectible binocular difficulty.

KENNETH L. ROPER, M.D., AND
ROBERT E. BANNON, B.S.,
Hanover, N. H.

Dartmouth Eye Institute.

1. Bielschowsky, A.: Congenital and Acquired Deficiencies of Fusion, Am. J. Ophth. **18**: 933 (Oct.) 1935. Burian, H. M.: Clinical Significance of Aniseikonia, Arch. Ophth. **29**: 131 (Jan.) 1943.

2. Roper, K. L., and Bannon, R. E.: Diagnostic Value of Monocular Occlusion, Arch. Ophth., this issue, p. 316.

3. Burian, H. M.: Fusional Movements: Role of Peripheral Stimuli, Arch. Ophth. **21**: 486 (March) 1939.

CORRECTION

In the abstract of the article by Dr. W. Guernsey Frey entitled "Monocular Exophthalmos Due to Hyperthyroidism in a Patient with the Duane Syndrome" in the report of the November 15 meeting of the New York Academy of Medicine, Section of Ophthalmology, which appeared in the January issue (ARCH. OPHTH. **31**: 116, 1944), the penultimate paragraph should read:

"It appears that when hyperthyroidism developed, the left eye did not become exophthalmic to the same degree as the right, because of restraint exercised by a fibrotic external rectus muscle. That there was a strong factor favoring proptosis of this eye seems manifest by the swelling of the soft tissues of the globe observed in the eyelids."

News and Notes

GENERAL NEWS

Examinations for Technicians, American Orthoptic Council.—The next examination for technicians to be given by the American Orthoptic Council will be held in September and October 1944.

The written examinations will be held at various cities in the country on Sept. 7, 1944. Only candidates passing the written examinations will be permitted to take the oral and practical tests, to be given in Chicago, Oct. 7, 1944.

Applications, on the official form, must be received before Aug. 1, 1944.

Communications should be addressed to the American Orthoptic Council, 23 East Seventy-Ninth Street, New York 21.

Postgraduate Course in Neuromuscular Anomalies of the Eyes.—Dr. George P. Guibor is presenting the twelfth semiannual postgraduate course in neuromuscular anomalies of the eye at the Children's Memorial Hospital, Chicago, May 7 to 12 inclusive.

SOCIETY NEWS

Medical Society of the State of New York, Section on Ophthalmology.—The annual meeting of the Medical Society of the State of New York, Section on Ophthalmology, will be held May 10, 1944, at the Hotel Pennsylvania, New York.

The following papers will be presented:

"Treatment of Complications of Cataract Extraction." John H. Dunnington, M. D., New York.

Discussion: E. Clifford Place, M.D., Brooklyn, and Ivan J. Koenig, M.D., Buffalo.

"Ophthalmoscopic Signs of Terminal Hypertension." Arthur J. Bedell, M.D., Albany, N. Y.

Discussion: Searle B. Marlow, M.D., Syracuse, N. Y., and Morris H. Newton, M.D., Little Falls, N. Y.

"Interpretation of Visual Fields in Neurotic Patients." John F. Gipner, M.D., Rochester, N. Y.

Discussion: Thurber Le Win, M.D., Buffalo, and Walter F. Duggan, M.D., Utica, N. Y.

"Evaluation of Newer Drugs Used in Ophthalmology." Walter S. Atkinson, M.D., Watertown, N. Y.

Discussion: Albert C. Snell, M.D., Rochester, N. Y., and Ludwig von Sallmann, M.D., New York (by invitation).

"Progress of the Glaucoma Campaign During the Past Three Years." Mark J. Schoenberg, M.D., New York.

Discussion: Frank M. Sulzman, M.D., Troy, N. Y., and E. Perry Hall, M.D., Oneonta, N. Y.

Association for Research in Ophthalmology, Inc.—The annual meeting of the Association for Research in Ophthalmology, Inc., will be held at the Sherman Hotel, in Chicago, on Tuesday, June 13, 1944.

Members who desire to present papers or to contribute to the program are requested to communicate with Major Brittain F. Payne, The School of Aviation Medicine, Randolph Field, Texas, who is assembling the program.

PERSONAL NEWS

Appointment to Army Medical Library.—Dr. William Thornwall Davis, Washington, D. C., has been made an honorary consultant to the Army Medical Library.

CORRECTION

In the communication by Major H. S. Sugar in the March issue (ARCH. OPHTH. **31**: 269, 1944) in the twelfth line of the second column, "for each 8 mm." should read "for each of the 8 mm."

Obituaries

SANFORD ROBINSON GIFFORD, M.D.
1892-1944

The death of Sanford R. Gifford, on February 25, at the early age of 52, after a short illness, was a great shock to his many friends and is an irreparable loss to ophthalmology. It may be truly said that he gave his life to his profession. He was outstanding as a scientist, writer, director of research, teacher and clinician, a remarkable and unusual combination, and his death, as he was approaching the zenith of his career, was a tragedy.

Sanford Gifford was born in Omaha, on Jan. 8, 1892, the son of Dr. Harold Gifford, the eminent ophthalmologist. After graduating at Cornell University, he received the degree in medicine at the University of Nebraska College of Medicine, Omaha, in 1918. During World War I he served as bacteriologist in the United States Army, with the rank of first lieutenant. On his return to Omaha, in 1919, he practiced with his father and was instructor in ophthalmology at the University of Nebraska College of Medicine, becoming assistant professor in 1924. During this period he was active in research and hospital work and gave promise of his future development as a scientist and a clinician. In 1920 articles from his pen began to appear in the special journals—generally on clinical observations and on the bacteriology of the eyes. In 1923-1924 he studied at the University of Freiburg, Baden, and at the Universities of Vienna and Tübingen; there he became acquainted at first hand with the ophthalmology of continental Europe, particularly from the laboratory standpoint, and learned the value of research.

An important decision for his future life was made in 1929, when he moved to Chicago and joined the staff of the Northwestern University Medical School. His talents then came to the fore, and in this important stage in his career he served as professor and chairman of the department of ophthalmology, a position he held at the time of his death. He was head of the department of ophthalmology and a member of the staff of Passavant Memorial Hospital and had served as attending ophthalmologist at Cook County Hospital since 1932.

At Northwestern University his vigorous capacity for constructive administration found congenial and profitable opportunity. He achieved, with a minimum of officiousness and dissension, most satisfactory administrative results in the many opportunities which the large city of Chicago, with its diversified interests, offers.

Dr. Beulah Cushman furnished me with the data on his work at Northwestern.

Dr. Gifford developed the ophthalmic clinic at Northwestern University into an active clinic with a postgraduate course. An organized postgraduate course was offered in 1935 and continued to be given nine months each year, beginning in September. Each class was limited to 8 students. Altogether, 54 students had finished the course when it was discontinued at the close of the 1941-1942 term for the duration of the war. A residency was opened in Passavant Memorial Hospital in 1930 and in Wesley Memorial Hospital in September 1941. A fellowship in ophthalmic surgery was established which was open to the residents in 1939. The undergraduate training was carried on by the staff, except for the ophthalmic clinic at Cook County Hospital, which Dr. Gifford conducted. The sessions at this clinic were very popular, and many of the senior medical students became actively interested in ophthalmology. He was most enthusiastic about all research and encouraged every member of the staff to take up some problem, to the investigation of which he contributed any funds that were needed, as well as his keen interest and knowledge. The department of photography was developed by the help of his special gifts and enthusiasm, and the first exhibit of kodachrome photographs of external diseases of the eyes held at a meeting of the American Academy of Ophthalmology and Otolaryngology was possible through his encouragement and gifts. The aniseikonia clinic was opened in 1941, and two physicians received their training at the Dartmouth Eye Institute through his foresight and gifts to the department.

He had the pen of a ready writer and expressed himself freely and concisely. Dr. Harold Gifford tells me of the significant fact in his brother's education that he originally wanted to teach English literature and that his entire four years of college were devoted to the arts, rather than to the sciences. After teaching for a year at the University of Omaha, he decided to study medicine, and it was necessary for him to cram in his

premedical science courses at a terrific rate. In the medical school he was an honor student, but had to stay up late at night with his studies. He would frequently go to sleep in class, and there is an old joke in Omaha that "Sandy" knew more when he was asleep than the rest of the students did when they were awake. His ability as a teacher and writer goes back to this earlier training in English literature.

and up-to-date information. The "Textbook of Ophthalmology" contains a wealth of clinical material and experience, formulated in a clear, concise and by no means dry manner. In his research work, he never lost sight of its practical bearing. He was particularly interested in bacteriologic problems and in the biochemistry of the lens. With Dr. J. M. Patton, he reported the probable etiologic agent of the hitherto un-

SANFORD ROBINSON GIFFORD, M.D.
1892-1944

In addition to many monographs on the bacteriology of the eyes, especially diseases due to fungi and the higher bacteria (Diseases of Eye and Adnexa Due to Fungi and Higher Bacteria, ARCH. OPHTH. **57:** 224 [May] 1928), Gifford was the author of "A Hand-Book of Ocular Therapeutics" (Philadelphia, Lea & Febiger, 1937) and "A Textbook of Ophthalmology" (Philadelphia, W. B. Saunders Company, 1938). The book on "Ocular Therapeutics" is the standard work of reference in the English language and is an indispensable source of accurate

known disease agricultural conjunctivitis. At the same time, any clinical problem which presented possibility for research in its elucidation was eagerly grasped. He had been associate editor of the ARCHIVES since 1928 and was corresponding editor of the *Klinische Monatsblätter für Augenheilkunde*. His loss to the ARCHIVES is enormous, not only on account of the many contributions that he and his staff made, but for his ever present readiness to help and to work. He had an excellent knowledge of several languages and an unusual grasp of medical, especially oph-

thalmologic literature. Diseases of the fundus, which revealed his interest in the problems of general medicine, were of great attraction to him; of articles on this subject, his recent publications on "Central Angiospastic Retinopathy" and "Vascular Retinopathy" are notable. He was a sound surgeon, with excellent judgment and operative skill, and he devised several new procedures for the correction of ptosis and other muscular defects.

Gifford was a member of the American Ophthalmological Society, the American Academy of Ophthalmology and Otolaryngology, the Association for Research in Ophthalmology, Inc., the American College of Surgeons and the Institute of Medicine of Chicago.

Gifted in mental powers of a high order, he added to these industry, determination and imagination and in a relatively short life achieved unusual eminence in his profession and made permanent contributions to ophthalmology. There is no branch of his specialty that did not interest him and to which he did not contribute. As a teacher and lecturer he had unique gifts. In public speaking his presentation was clear and to the point and was delivered with sincerity and dignity, and with just the right touch of humor. His energy was untiring and enabled him to carry on the enormous amount of work which his daily routine demanded.

The many qualities that helped to make Sanford Gifford the outstanding man he was were most apparent. It is not strange that his charm of manner and his forthcomingness drew men to him. He was a man of taste, culture and wide interest and was appreciated not only for his skill but for his straightforwardness, kindliness and tact. He was fortunately blessed with a family life of singular happiness. He is survived by a wife, who stood by his side with understanding heart and wise counsel, and by 2 sons, the older, Sanford R. Jr., a physician, and the younger, Carter, an architect, who are both in military service. Those who have known and worked closely with Sanford Gifford are mourning a dear friend with memories of deep affection and of high regard, and the medical profession has lost an outstanding personality.

ARNOLD KNAPP.

With the passing of Sanford Gifford ophthalmology has lost a brilliant scientist and I have lost an intimate friend. To those who knew him well he was known as "Sandy," and it is to "Sandy" as a friend that I wish to pay my tribute.

In 1922, when I attended my first meeting of the Section on Ophthalmology of the American Medical Association, in St. Louis, alone and without an acquaintance, it was "Sandy" Gifford who took me under his wing and saw to it that I enjoyed the meeting. From this developed a friendship that became more intimate through the years. I have spent many pleasant hours as a guest of "Sandy" and his gracious, charming wife, and have thus seen their beautiful home life and the happiness they derived from their two sons.

In 1939 "Sandy" became a member of the Bohemian Club of San Francisco and started attending the midsummer encampments in the club's 3,000 acre redwood grove, 60 miles north of San Francisco. Since we were members of the same camp, it was here, away from the hurry, tension and responsibility of daily routine, that I learned to know him well. It was during the first, more quiet, part of the encampment that we had many intimate talks, while going to the swimming hole, walking through the forest or sitting around the campfire at night. It is the memories of these hours that seem most dear, for it was here that at close hand I observed the qualities that endeared him to all who knew him.

He was first of all a scientist and an ophthalmologist, but it is as a great clinician that most of his associates will remember him. He always had an open mind and was ever ready to acknowledge the good in others' work. If he adopted a new procedure, he was most careful to give credit where credit was due. "He was so gentle and wisely just in all his dealings," kind and considerate of others and, above all, charitable toward the weaknesses and failings of his fellow man and fellow practitioner. His modest, unassuming bearing, combined with a sincere interest in the welfare of the younger men, endeared him to them. They had a profound respect for him but were always at ease in his presence.

Beneath the serious exterior was a keen sense of humor, which is well illustrated in his delightful account of his experiences in his father's office in Omaha. To this paper, which he read before the Chicago Literary Club, he gave the title, "Garlic and Old Horse Blankets (Being Some Presenile Reminiscences by Sanford R. Gifford)."

In addition to his attainments in ophthalmology, "Sandy" had an appreciation of literature and music. Reading was one of his favorite means of relaxation. I have a highly prized

photograph of him taken at the grove in his favorite spot in camp, dressed in shorts, semi-reclined on a "sun chair," smoking his beloved pipe and reading a book on the history of Greece. He never tired of music and always looked forward to the evening concerts out under the redwoods or at the lake.

To have known "Sandy" as a colleague, as a camp mate and, above all, as a comrade has been a rare privilege. The memory of those associations will continue to be an inspiration, not only to greater attainments in ophthalmology, but to the finer things in life.

In a little while there will be another midsummer encampment. The ageless redwoods of the forest, the swimming hole, the camp and the nights before the fire await me as of yore, but it will not be the same. "Sandy" will not be there.

FREDERICK C. CORDES.

Words cannot portray the rare personality we knew as "Sandy." Gentle, kindly, modest and self effacing, he possessed great strength. Out of his vast reservoirs of intellectual power there poured numerous contributions to the science of ophthalmology, painstaking care of patients and teaching that was both accurate and stimulating.

But he was far more than an accomplished specialist. Had he devoted himself to literature he would have added much to the prestige of American letters. Among my most prized possessions are a few verses which are worthy of the immortal Keats. He inscribed them—long ago—to his mother on her birthday. Few equaled his natural flair for writing. His mind pictured at once every facet of scene and incident. His seriocomic essay "Garlic and Old Horse Blankets" (privately printed, 1943) will endure. Its very whimsicality reflects a playful mood which rarely deserted him.

It seems as though I had known him always. He wasn't much more than 10 when I first glimpsed the spindling lad who was so adventurous, so curious. His parental home was the gathering place for the neighborhood youngsters. Although many were older than he, leadership was his by natural right. Only in after years did he relate how, with a companion, he climbed the well of the high school tower, with the narrowest of toe and finger holds offered by jutting bricks and sills.

The spirit of youth never forsook him. His enthusiasm was contagious and his industry the marvel of his colleagues. He thought long thoughts. By temperament, he was an artist.

The ashes of this noble man repose in a quiet spot in far-off California, where—a few years hence—he had hoped to find surcease from the chores of the day, with some leisure for writing. Those who must carry on will not fail to hear his words of encouragement. They will envision his quizzical smile and catch his understanding chuckle.

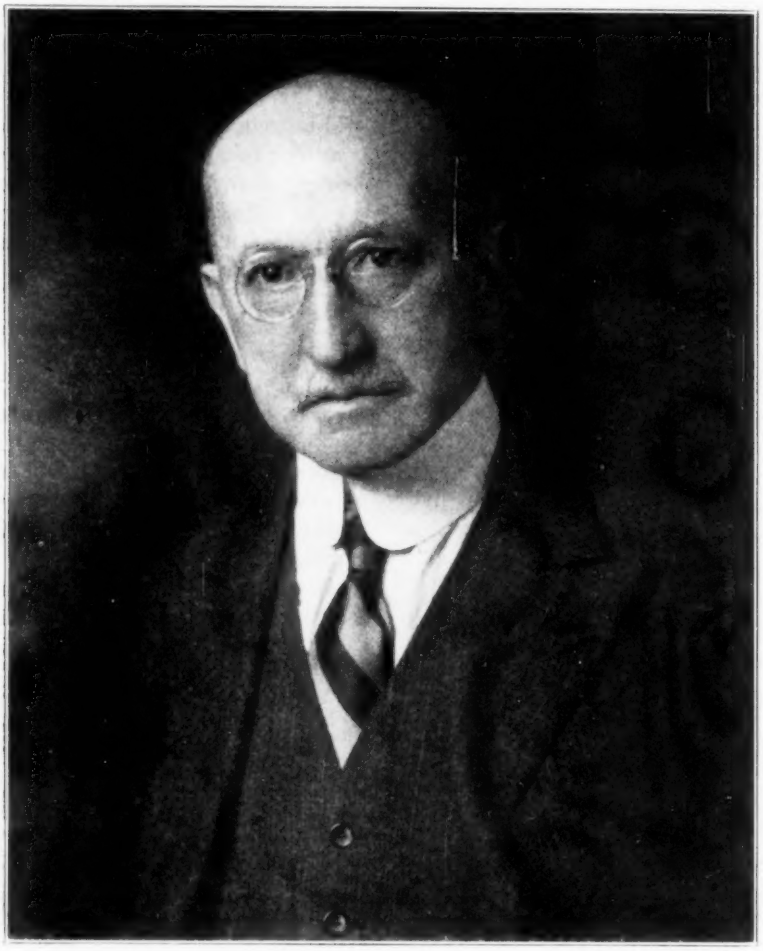
In all humility we bow before Ultimate Truth, which he exemplified so valiantly.

IRVING S. CUTTER.

CARL KOLLER, M.D.
1857-1944

With the passing of Dr. Koller, it is fitting to emphasize once again the achievement for which he will be remembered—his discovery of the use of cocaine for local anesthesia. This discovery, in 1884, marked the beginning of local anesthesia as it is now known. He was searching for a substance which might be used for this purpose and, while studying the systemic action of the drug, noted the benumbing effect of cocaine on the tongue. This led him to experiment with it for local use. The story has been told many times, but, because of errors and confusion about it which had cropped up in the course of the years, he retold it in detail in 1927, at a joint meeting of the Associated Anesthetists of the United States and Canada and the International Anesthesia Research Society and published his notes in *The Journal of the American Medical Association* (**90:** 1742 [May 26] 1928) and in a number of European journals.

In his early years, during student and intern days, he worked in embryology in Stricker's laboratory, in Vienna, and published in 1879 and 1882 his observations on the origin of the mesoderm as studied in the chicken embryo. This work represented an original idea he had about the mesoderm, which proved correct on investigation. Dr. Koller thought well of this achievement and spoke of it frequently in his later years. He received his training in ophthalmology in



CARL KOLLER, M.D.
1857-1944

Vienna under Arlt and in the Eye Hospital in Utrecht, Netherlands, which was then conducted by Professors Snellen and Donders.

He continued to experiment during many years, interesting himself in astigmatism, improvements in the ophthalmometer and other subjects. He devised, among other things, the lighting system now being used in the electric ophthalmoscope. He also wrote many articles on clinical subjects in ophthalmology.

In general, it may be said of Dr. Koller that his mind was essentially scientific, keen and inquiring throughout his long life, although he was a most successful practicing ophthalmologist, noted as an outstanding diagnostician and surgeon. He practiced in New York from 1888 to 1942 and was associated with the Mount Sinai Hospital for many years.

He was not a calm person, nor had he ever any hesitation about expressing criticism, whether of himself or of others, if he discovered error. Like all scientifically minded people, he despised insincerity in medical science and practice and often jibed at it.

To all with whom he came in contact, he was a stimulating personality, always speculating and wondering about the unknown and the unsolved problems in all lines of endeavor. Friends, colleagues and patients sensed in him a real person—true, reliable and fearless—no matter what the surface manifestation.

He was honored by various societies for the work with cocaine, receiving medals from the American Ophthalmological Society, in 1922; the University of Heidelberg, Germany, in 1928; the New York Academy of Medicine, in 1930 (it's first award), and the American Academy of Ophthalmology and Laryngology, in 1934.

Also, he received a scroll of recognition from the International Anesthesia Research Society and honorary membership in a number of societies here and in Europe.

Dr. Koller was a credit to his chosen profession, and his work remains a boon to mankind.

SELINA BLOOM.

CHARLES EDWARD FINLAY, M.D.

1868-1944

Dr. Charles Edward Finlay died at the age of 76 in his home in Habana, Cuba, on March 17, after a prolonged illness. He was born in Habana, the son of the celebrated Dr. Carlos J. Finlay, who was closely identified with yellow fever research. After his graduation from Columbia University College of Physicians and Surgeons, in 1889, he was connected with the New York Ophthalmic and Aural Institute from 1889 to 1892, as an assistant to Dr. Herman Knapp. He then returned to Habana and began an active career. He received the degree of Doctor of Medicine from the University of Habana in 1900 and was a member of the board of directors of No. 1 Hospital, Habana, and of the Central Board of Charities. He began to teach at the Habana Medical College in 1904, became professor of diseases of the eye, after a competitive examination, in 1907. He was director of charities in Habana in 1921-1922; president of the executive committee of the First National Cuban Medical Congress in 1921; delegate for Cuba to the International Congress of Ophthalmology, Washington, D. C., in 1922; honorary president of the Seventh National Cuban Medical Congress in 1924, and vice president of the Habana Medical College in 1925. He became a member of the American Ophthalmological Society in 1927. In 1933 Dr. Finlay returned to the United States and became research fellow at the Eye Institute of the Presbyterian Hospital for one year, in 1933. In the same year he was appointed director of charities in Cuba and received the Grand Cross of the Finlay Order.

He served as dean of the medical school of the University of Habana from 1934 to 1937. In 1938 he became identified with sanitation; he acted as health officer for Habana in 1938 and director of public health for Cuba in 1939; he was a member of the American Public Health Association and represented Cuba at the meeting of the Public Health Congress in Washington, D. C., in 1940. In 1941 he was elected vice president of the American Public Health Association and emeritus professor of ophthalmology in the University of Habana.

Dr. Finlay was a frequent contributor to the special journals on ophthalmology, and many of his publications and abstracts from the South American journals of ophthalmology appeared in the ARCHIVES. His articles were generally of a clinical nature. One of his interesting observations was entitled "Bitemporal Contraction of the Visual Fields in Pregnancy" (ARCH. OPHTH. **52**:50 [Jan.] 1923). He wrote on his father's work in connection with yellow fever on a number of occasions and published a book entitled "Carlos Finlay and Yellow Fever," which appeared in New York in 1940. His translation into Spanish of May's "Manual of Diseases of the Eye" was published in Habana in 1939. Many of his recent papers were concerned with sanitation and public health.

Dr. Finlay was modest and hard working. He lived a useful life in his home city of Habana, occupying a number of civic positions, in addition to carrying on an active practice, and as teacher of ophthalmology he undoubtedly contributed to the appreciation of American ophthalmology in Cuba.

He leaves a wife, five daughters and two sons.

ARNOLD KNAPP.

ADOLPH O. PFINGST, M.D.

1869–1944

Dr. Adolph O. Pfingst, the dean of Kentucky ophthalmologists, died on February 25, aged 75, of coronary occlusion, at his home in Louisville, Ky. He was the son of H. Adolph Pfingst, pioneer druggist in that city. After graduating from the Louisville High School, he received his degrees of Bachelor of Arts and Doctor of Medicine from the University of Louisville. He interned at the Louisville City Hospital and filled a part term at Mt. Sinai Hospital, New York. He then went to Europe to take up the study of ophthalmology. After spending a year in the study of pathology and bacteriology at Marburg, Germany, under the guidance of Professors Marchand and Fraenkel, he began his studies in ophthalmology under Professors Uhthoff and Axenfeld. In 1893-1894 he worked in the University Eye Clinic in Berlin and at the same time wrote his thesis for the degree of Doctor of Medicine from the University of Berlin. In 1895 Dr. Pfingst returned to this country and became house surgeon to Dr. Herman Knapp at the New York Ophthalmic and Aural Institute for one year. After this thorough training he returned to his home town and established himself as an ophthalmologist, continuing his work in the bacteriologic and histologic laboratories. In 1906 he was appointed professor of ophthalmology in the University of Louisville and director of the ophthalmic clinic

ADOLPH O. PFINGST, M.D.

1869-1944

at the Louisville City Hospital, which position he occupied until 1938, when he retired with the title of professor emeritus.

Dr. Pfingst was a member of the American Ophthalmological Society and served on the council for a number of years. He was a member of many other special and general societies. He was always interested in civic affairs; he organized the first sight-saving class in Louisville and was active in the national movement for the prevention of blindness.

He made a number of important contributions to scientific medical literature on subjects usually connected with the pathology of the eye and on diseases and anomalies of the intracranial blood vessels.

He is survived by his wife, Mrs. Lula Solger Pfingst. With his training and natural aptitude, Dr. Pfingst became a sound ophthalmologist, thorough and earnest in his work, and was a worthy representative of his specialty. A man of sterling qualities, a kindly and strong personality, a simple, unaffected man of transparent honesty, he will be missed by a large circle of friends.

ARNOLD KNAPP.

Dr. Adolph O. Pfingst was one of the few in whom are present all of the attributes necessary to make the ideal physician. Skill and diligence in the practice of ophthalmology, equanimity, humility, humaneness, unselfishness and human understanding—all these were in happy combination.

As a teacher he excelled. Qualifying himself by thorough postgraduate training, unusual fifty years ago, he immediately began a long teaching career. One of his first courses was in bacteriology, for which he wrote his own textbook, no other being available at that time. When ophthalmology and otolaryngology were included in the curriculum, he became an instructor in these subjects, and in time was made professor of ophthalmology and chief of the department in the University of Louisville School of Medicine, which position he held for many years. His favorite method was that of quizzing, during which he learned the names of all his pupils. His memory was such that, years later, when former students called on him in his office, he could call them by their first names. His appearance belied the fact that he was never a man of robust health, and as time passed and his private practice grew large, he reluctantly was forced to give up his teaching. However, his interest in medical education never waned.

It was inevitable that Dr. Pfingst should enjoy a busy private practice, so that many times his strength was sorely taxed to serve all who sought his help. Yet he never became impatient, but always was painstakingly careful to see that each patient was given proper attention. As a result, he was dearly beloved by his many patients.

While his profession came first, Dr. Pfingst had a diversity of interests. He was a lover of music and a follower of all kinds of sports and participated in many civic activities.

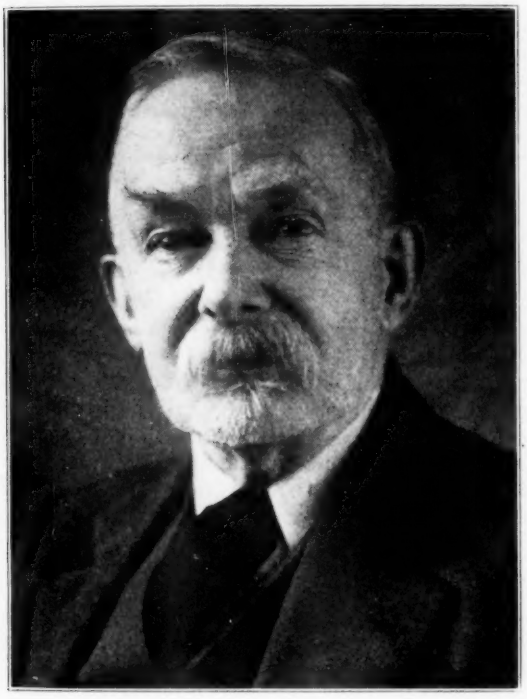
One of the most beautiful memories of this great man is his tender devotion to his wife and family. This happy home life encouraged, supported and inspired him throughout his entire career.

To have been the pupil and associate of such a man was a rare privilege indeed.

C. DWIGHT TOWNES.

EDMOND EDUARD BLAAUW, M.D.
1867–1943

Edmond Eduard Blaauw was born in Arnheim, Netherlands, in 1867, the son of a cavalry officer. One of a family of 4 boys, he was brought up near The Hague in a simple and artistic atmosphere. He began his medical studies at the age of 19, at the University of Amsterdam, spending a number of years in study in Freiburg, Germany, and Lyon and Paris, France. He then became assistant to Professor Gunning, at the Amsterdam Eye Hospital, and graduated in 1894, with the publication of a thesis on trachoma. He then married and came to this country, settling in Buffalo.



EDMOND EDUARD BLAAUW, M.D.
1867-1943

Dr. Blaauw was associated with the German Deaconess Hospital and the Buffalo Eye and Ear Dispensary, and was a member of the American Medical Association, the Academy of Ophthalmology and Otolaryngology, the Buffalo Academy of Medicine and the Erie County Society and a number of European societies.

He was a faithful attendant at medical meetings and, beginning with 1900, contributed many articles to ophthalmic journals. Some of the articles were on the physiology and anatomy of the eye, but most were clinical. Illustrative of his interests were the articles entitled "Aging of the Eye," a translation of the views of Vogt and Rochat (ARCH. OPHTH. **2**: 468 [Oct.] 1929) and an obituary of Allvar Gullstrand (ARCH. OPHTH. **5**: 294 [Feb.] 1931).

He continued his association with European ophthalmologists and frequently attended the meeting of the German Ophthalmological Society, in Heidelberg, and the international congresses. A trip around the world was a particularly important incident in his life and enabled him to visit the hospitals in Japan, China, Netherland East Indies and British India.

In 1941 he broke his hip and then heart trouble developed; this made him more or less of an invalid and led to his death, on Dec. 4, 1943.

Dr. Blaauw was of a studious nature, preferring to spend his spare time in his library, where he had collected 10,000 volumes, in four languages. His knowledge of the literature was exceptional, and he was often called on to look up topics for his colleagues.

An agreeable personality, of great intellectual honesty, he was more interested in the science of ophthalmology than in the practice of it. At the same time, he was an ideal physician, unselfish, free from any prejudices and ready to help both rich and poor. Beloved and respected by his colleagues and patients, to whom his death is a great loss, he leaves the memory of a noble character and of a striking personality.

ARNOLD KNAPP.

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Comparative Ophthalmology

CHOLINE ESTERASE IN THE AMPHIBIAN SPHINCTER PUPILLAE. P. B. ARMSTRONG, J. Cell. & Comp. Physiol. **20:** 47 (Aug.) 1942.

In his studies on the action of acetylcholine on the sphincter pupillae of excised eyes of recently metamorphosed salamanders (Amblystoma opacum and Amblystoma punctatum), the author observed that the threshold for stimulation of the sphincter was considerably higher in eyes in which the cornea was left in place than in eyes from which the cornea had been removed. A marked potentiation of the action of acetylcholine by physostigmine was readily obtained in eyes with an intact cornea and was absent after removal of the cornea. The experimental data appear to indicate that choline esterase is either completely lacking or present only in minute amounts at the parasympathetic postganglionic terminations in the amphibian sphincter pupillae, in contrast to the relatively high concentrations of esterase at most peripheral nerve endings. L. VON SALLMANN.

Injuries

AN INTERESTING CASE OF RUPTURE OF THE CHOROID. E. ROSEN, Brit. J. Ophth. **27:** 552 (Dec.) 1943.

After an injury to the right eye by a piece of wood flying, end over end, the pupil became eccentric and partially dilated, the lens was partially dislocated and four tears were present in the choroid. The two smaller tears were situated close to the macula. The second rupture, shaped somewhat like a spear head, seemed very close to the macula. The third and fourth ruptures were typically crescentic. While the author was preparing to report this case, he encountered a second case with four ruptures of the choroid. W. ZENTMAYER.

Instruments

EVALUATION OF ORTHOPTIC INSTRUMENTS. E. K. STARK, Am. J. Ophth. **26:** 1308 (Dec.) 1943.

Stark concludes that the major amblyoscopes (synoptophore, synoptoscope and orthoptoscope) are the instruments preferred. The stereo-orthopter facilitates the development of fusion. The rotoscope affords particularly effective exercise for correction of vertical disturbances.

W. S. REESE.

Lacrimal Apparatus

DACRYOCYSTORHINOSTOMY: THE LOGICAL TREATMENT FOR OCCLUSION OF THE LACRIMAL SAC. A. V. HALLUM, J. M. A. Georgia **32:** 186 (June) 1943.

Hallum concludes that dacryocystorhinostomy is the operation of choice in all cases of occlusion of the lacrimal sac, except when the puncta and canaliculi are occluded or when the sac is involved by a malignant or tuberculous process. The operation has proved highly successful in the hands of many operators, and the surgeon should feel that it is his moral obligation to his patient to reestablish intranasal drainage of the lacrimal sac. W. ZENTMAYER.

Lens

LENS EXTRACTIONS FOLLOWING FILTERING OPERATION FOR GLAUCOMA. S. R. GIFFORD, Am. J. Ophth. **26:** 468 (May) 1943.

Gifford states that his experience with a series of cases of cataract following a successful filtering operation has shown that extraction by the temporal route is a practical method of dealing with the problem. In only 1 case did tension rise appreciably above the level present before cataract extraction, and the filtering scars showed little change. There were no operative complications directly referable to the method.

The article is illustrated.

W. ZENTMAYER.

ORAL USE OF PROPHYLACTIC SULFADIAZINE FOR CATARACT EXTRACTIONS. J. S. GUYTON and ALAN C. WOODS, Am. J. Ophth. **26:** 1278 (Dec.) 1943.

In a series of 312 cataract extractions in which sulfadiazine was used prophylactically, postoperative infection was significantly lower than in two control series of 159 and 642 extractions respectively. W. S. REESE.

ENDOPHTHALMITIS PHACO-ANAPHYLACTICA. R. C. SCOBEE and H. C. SLAUGHTER, Am. J. Ophth. **27:** 49 (Jan.) 1944.

Scobee and Slaughter give the following summary:

"Herewith is presented confirmation of Burky's work of 1934; namely, that cutaneous sensitivity to lens substance in rabbits can be induced by repeated and coincident injections of staphylococcus toxin and lens substance. When the eyes of such sensitive rabbits are needled, a

clinical and histologic picture develops that resembles endophthalmitis phaco-anaphylactica in man. Our series did not show the cutaneous sensitivity which Burky mentioned, yet end results were the same. We report this confirmation of Burky's work as the first step in a series of experiments having to do with endophthalmitis phaco-anaphylactica and sympathetic ophthalmia."

W. S. Reese.

Methods of Examination

The Use of Pseudo-Isochromatic Charts in Detecting Central Scotomas Due to Lesions in the Conducting Pathways. L. L. Sloan, Am. J. Ophth. **25:** 1352 (Nov.) 1942.

Sloan recommends Ishihara charts for the quick and simple detection of central scotoma, the charts being viewed from a distance of 1 meter. She feels that these charts constitute a reliable test but that normal responses do not rule out the presence of a central scotoma.

W. S. Reese.

Entoptic Methods in Clinical Investigations. B. Friedman, Am. J. Ophth. **26:** 235 (March) 1943.

This interesting article suggests that more use should be made of entoptic phenomena in determination of intraocular disease when opaque media do not permit ophthalmoscopic examination.

W. S. Reese.

Retroillumination. R. I. Lloyd, Am. J. Ophth. **26:** 799 (Aug.) 1943.

Lloyd expresses the hope that retroillumination will be made a part of the regular routine of enucleation in ophthalmic hospitals. If this is accomplished, it will soon be known whether tumor can be differentiated from other masses in the fundus.

W. Zentmayer.

Present Limits of Gonioscopy. P. C. Kronfeld and H. I. McGarry, Am. J. Ophth. **27:** 147 (Feb.) 1944.

Kronfeld and McGarry give the following summary:

"The present status of gonioscopy may be summed up by listing some of its plus as well as its minus values.

"Plus values of gonioscopy: 1. Gonioscopy offers a simple mechanical explanation for certain glaucomas. 2. Gonioscopy helps choose the type of operation most suitable for the case under consideration. 3. Gonioscopy helps recognize the causes of failure of glaucoma operations. 4. The information obtained by gonioscopy is of prognostic value in that it enables us to tell whether or not a filtering operation will continue to function. 5. The information obtained by gonioscopy may be of value in inflammatory and traumatic diseases of the eye.

"Minus values of gonioscopy: 1. Gonioscopy offers no explanation of the mechanism of certain glaucomas. 2. Gonioscopy requires some special equipment. From 2 to 4 hours are required to learn the technique of gonioscopy. Considerable experience is required to interpret cases in which the landmarks have been obliterated. 3. Gonioscopy is conducive to the development of an over-mechanical concept of glaucoma."

W. S. Reese.

Neurology

The Psychoneurotic Factor in Ophthalmic Practice. C. A. Bahn, Am. J. Ophth. **26:** 369 (April) 1943.

Bahn reviewed a series of 400 consecutive office cases, 215 of men and 185 of women. In his opinion a psychoneurotic factor that was capable of effecting symptomatic recovery existed in 301 cases. He gives the following summary:

"The rate of psychoneuroses in ophthalmic practice is 75 per cent compared with 50 per cent in general practice.

"Psychoneuroses involving the eyes are essentially due to imbalance of the autonomic nervous system.

"Symptomatic manifestations are: visual, sensory, secretory, vasomotor and motor disturbances.

"The functional element of the patient's symptoms is usually easily separated from the organic elements.

"Health routines are the only practical treatment of the functional element.

"Health routines integrate all of the fundamentals of physical and mental hygiene in the correct timing, the proper order, and the most intelligent manner.

"A basic health routine is given in detail and its adaptation explained and illustrated by case reports."

W. Zentmayer.

Choked Discs and Low Intrathecal Pressure Occurring in Brain Tumor. P. J. Leinfelder, Am. J. Ophth. **26:** 1294 (Dec.) 1943.

Leinfelder presents the significant data in 12 cases of tumor of the brain, low intrathecal pressure and choked disk. He concludes from the evidence available that the condition in these cases should be considered as true hydrocephalus, the lumbar pressure remaining unexplained except in a few instances.

W. S. Reese.

Experimental Studies on Headache. E. Kunkle, B. Ray and H. Wolff, Arch. Neurol. & Psychiat. **49:** 323 (March) 1943.

The authors infer that headache following drainage of cerebrospinal fluid is caused primarily by traction by the brain on various pain-

sensitive structures which anchor it to the cranium; dilatation of some of these structures, the intracranial veins and increase in brain volume are suggested as joint factors in the augmented traction which follows drainage of fluid and leads to headache.

The headache so often associated with increased intracranial pressure has generally been assumed, but never proved, to be related to the increased pressure. Yet (*a*) elevation of intracranial pressure in normal human subjects to abnormally high levels failed to cause headache; (*b*) in a series of 72 patients with tumor of the brain, headache occurred almost as frequently with normal as with increased pressure, and (*c*) headache homolateral to the lesion in a patient with a tumor of the brain was induced by lowering the intracranial pressure, but could not be induced by elevation of the pressure to a high level of 5.5 mm.

Hence in the production of headache, increased intracranial pressure is neither a prime nor an essential factor.

From these data it is concluded that the headache associated with either decreased or increased intracranial pressure results from traction on or displacement of pain-sensitive intracranial structures and is independent of generalized intracranial pressure changes themselves.

R. IRVINE.

BILATERAL THROMBOSIS OF THE POSTERIOR CALCARINE ARTERIES WITH SPARING OF MACULAR VISION. R. MCDONALD, Arch. Neurol. & Psychiat. **49:** 484 (March) 1943.

A case of bilateral hemianopsia caused by bilateral thrombosis of the calcarine arteries is presented. The patient had as his only complaint complete loss of peripheral vision. With correction vision was 6/6 in both eyes, and he read Jaeger test type 1 without difficulty. The results of neurologic and medical examinations were essentially normal. The patient had first, second and third grade fusion as tested on the synoptophore, and optokinetic nystagmus was readily elicited in all directions.

The cortical representation of vision and the vascular supply to the area striata are discussed.

First, in all likelihood the macular regions in the occipital pole are frequently supplied by branches of the middle cerebral rather than branches of the posterior cerebral artery. This is important because it at once fixes in mind the reason that with lesions in the temporal lobe there is complete hemianopsia, whereas with lesions of the occipital lobe there is frequently sparing of the macula.

It is concluded that peripheral vision is not essential for stereopsis or spatial orientation and that optic nystagmus may be elicited even if the field is reduced to about 2.5 degrees on either side of fixation. Apparently, the performance of the complex visual functions are dependent on macular fixation and on certain associated pathways which are not closely connected with the cortical areas supplying peripheral vision.

R. IRVINE.

MYASTHENIA GRAVIS: CURARE SENSITIVITY; A NEW DIAGNOSTIC TEST AND APPROACH TO CAUSATION. A. BENNETT and P. CASH, Arch. Neurol. & Psychiat. **49:** 537 (April) 1943.

The authors summarize their presentation as follows:

"1. It appears that some failure in the action of acetylcholine exists in myasthenia gravis.

"2. Physostigmine restores neuromuscular performance in most myasthenic patients.

"3. Curare neutralizes acetylcholine action and produces artificial myasthenia gravis.

"4. There is some evidence that a primary muscle disorder apart from neuromuscular block may occur in certain stages of the disease.

"5. The myasthenic patient exhibits a pronounced sensitivity to curare. One-tenth the usual physiologic dose of curare produces profound exacerbation of existing symptoms, and generalized curarization adds new symptoms of myasthenia.

"6. These phenomena suggest a specific diagnostic test for the disease. Injection of one-tenth the usual physiologic dose of standardized curare is a safe procedure if followed by administration of prostigmine methylsulfate. Larger doses must be administered with caution, as fatalities may occur.

"7. Five patients with different phases of the myasthenic syndrome have shown a specific response to the curare diagnostic test, even though for some the prostigmine test was inconclusive.

"8. The cause of myasthenia gravis should be found by explaining the occurrence in the disease of the neurophysiologic disturbance resembling chronic curarization." R. IRVINE.

JUVENILE AMAUROTIC IDIOCY: A CLINICOPATHOLOGIC STUDY. A. LUBIN and O. MARBURG, Arch. Neurol. & Psychiat. **49:** 559 (April) 1943.

A case of the juvenile type of amaurotic family idiocy is described. The results of neurologic, psychologic, encephalographic and histologic studies are correlated, with particular reference to cortical activity. In spite of severe and widespread cellular alterations, many cortical functions were retained, and the electroencephalographic pattern was not especially impaired.

The disorder in this case was typical of the juvenile form of amaurotic family idiocy, from both the clinical and the pathologic aspect. There were: (1) initial onset of visual disturbances between the fifth and the eighth year, progressing

to total blindness in one or two years, with retinitis pigmentosa and optic nerve atrophy; (2) mental deterioration and behavior disturbances, progressive throughout the course of the disease; (3) convulsions, usually beginning fairly late; (4) other neurologic manifestations, such as ataxia, tremors, nystagmus and pathologic reflexes, usually appearing during the terminal phase, and (5) death, from ten to fifteen years after the onset.

From the pathologic picture it may be concluded that cortical alterations consist mainly of (1) diffuse lipidosis and swelling of ganglion cells; (2) completely asystematic, patchlike disappearance of cells, most striking in the third and fifth layers, and (3) sclerosis of the molecular layer, with loss of tangential fibers.

R. IRVINE.

Ocular Muscles

NEAR HORIZONTAL PHORIA AND DUCTION TESTS S. V. ABRAHAM, Am. J. Ophth. **26:** 271 (March) 1943.

Abraham gives the following summary of his study:

"From a detailed study of more than 4,000 cases, 300 typical cases have been presented to show how the various findings from near horizontal phoria and duction tests fall into three characteristic groups: I, the normals; II, the subnormals; III, the abnormals.

"Certain evidence is presented to suggest that, basically, group III may resemble group II.

"The relation of the base-in reading at 13 inches [33 cm.] to the interpupillary distance is emphasized.

"The effect of cycloplegia on the findings is shown not to be dependable even though tendency of cycloplegia to cause a reduction in the convergence activity is suggested."

He draws the following conclusions:

"The possibility of obtaining consistent dependable muscle findings exists, if attention is given to near horizontal phoria and duction tests.

"These findings permit classification, with a resultant opportunity of studying the characteristics of the groups.

"A classification is presented which the author has used for over 10 years with continued proof of its dependability."

W. S. REESE.

A VISUAL PHENOMENON RELATED TO BINOCULAR TRIPLOPIA. H. M. BURIAN, Am. J. Ophth. **26:** 1084 (Oct.) 1943.

A man aged 22, a student, had pronounced anisometropia and alternating divergent strabismus, which had undoubtedly existed from early childhood but which he was able to overcome by an effort of convergence. The singular feature in the case was the simultaneous presence in the double image test of two modes of localization of biretinal stimuli, a condition which is akin to binocular triplopia. There was no actual monocular diplopia, but the phenomenon demonstrated may be considered as a precursor to binocular triplopia.

W. ZENTMAYER.

Operations

RESTORATION OF THE LOWER CUL-DE-SAC. C. BERENS, Am. J. Ophth. **26:** 119 (Feb.) 1943.

Berens gives the following summary:

"In five patients, whose inferior culs-de-sac were obliterated by scar tissue, resulting in ectropion, the orbital scar tissue was excised and the conjunctiva undermined over the lower half of the cul-de-sac. Incision was made to the lower margin of the orbit. Three double-armed sutures were passed through the conjunctiva and lower eyelid to attach the conjunctiva to the inferior orbital margin. A good inferior cul-de-sac was formed in each case and a prosthesis could be worn with satisfaction."

W. S. REESE.

Parasites

OPHTHALMOSCOPIC OBSERVATION OF MICROFILARIAS IN THE VITREOUS OF PATIENTS INFECTED WITH ONCHOCERCIASIS. A. T. ESTRADA, Am. J. Ophth. **25:** 1445 (Dec.) 1942.

Estrada reached the following conclusions:

It is possible to observe the microfilarias in the vitreous with the electric direct image ophthalmoscope.

The microfilarias seem to be more abundant in the vitreous than in the anterior chamber.

Observation of the parasite is easier with the ophthalmoscope than with the slit lamp microscope. The organism may be seen with the ophthalmoscope in cases in which nothing is seen in the anterior chamber, and even in those in which biopsy specimens of the skin are negative for the parasite.

The examination is so easy that it can be made by general practitioners and by visiting nurses connected with sanitary missions in the infected areas.

Microfilarias can be observed in the vitreous at early stages in the development of the disease.

W. S. REESE.

Pharmacology

OPHTHALMIC OINTMENTS. L. M. SCHEINESON, Am. J. Ophth. **26:** 171 (Feb.) 1943.

Scheineson gives the following summary:

"1. Ophthalmic ointments in general are advantageous for certain types of drug application.

"2. Certain types of ophthalmic ointments are best for certain conditions.

"3. For ophthalmic use water-absorption bases are superior to other bases.

"4. These ointment bases have a low surface tension.

"5. Ophthalmic ointments should be buffered.

"6. The specific method for preparing several types of ophthalmo-therapeutic ointments is given in detail." W. S. REESE.

Refraction and Accommodation

THE GREAT USEFULNESS OF BICYLINDRIC COMBINATIONS IN THE EXPLORATION OF ASTIGMATISM. M. MARQUEZ, Am. J. Ophth. **25:** 1458 (Dec.) 1942.

Marquez gives the following summary:

"There is a skillful process of investigating, chiefly the small degrees of astigmatism, based on the unquestionable existence of biastigmatism, and consisting in the employment of every kind of bicylindric combination. The first cylinder corrects the corneal astigmatism according to ophthalmometric measures (by Javal-Schiøtz or another keratometer). The second cylinder is searched for (after the corneal astigmatism has been corrected, and, if necessary, the spheric refraction) by the clock dial, as in the usual process of subjective exploration of astigmatism until the intensity of all diameters is equalized. Once having found the two cylinders, the resultant single cylinder is obtainable (with or without a spheric fraction) by means of formulas, graphs (both processes having been described in the text of this paper), or tables. This bicylindric process has a sensitiveness much greater than that of Jackson's cross-cylinder test (which is only a special variety of the former) or any other subjective process for exploring astigmatism." W. S. REESE.

THE EFFECT OF UNDERCORRECTION AND BASE-IN PRISM UPON THE MYOPIC REFRACTIVE STATE. J. CHANCE, E. OGDEN and K. B. STODDARD, Am. J. Ophth. **25:** 1471 (Dec.) 1942.

From their studies the authors conclude that undercorrection of myopia and the wearing of base-in prisms have little, if any, tendency to reduce myopia unless the defect is pseudomyopia. W. S. REESE.

Trachoma

STUDIES ON THE INFECTIVITY OF TRACHOMA. L. A. JULIANELLE, Am. J. Ophth. **26:** 280 (March) 1943.

Julianelle gives the following summary of his investigations:

"Human conjunctival cells containing demonstrable trachomatous virus have been grafted successfully upon the chorioallantois of the developing chick embryo. Proliferation of the epithelial cells was not accompanied by multiplication of the virus itself, as judged by animal inoculation and microscopic examination. Direct injections of macerated infective tissues into the yolk similarly failed to support detectable propagation of the virus. As possible explanations for this failure are offered the exalted specialization of the virus and its prolonged period of lag." W. S. REESE.

Tumors

PRIMARY SARCOMA OF THE CHOROID. A. BARLOW, Am. J. Ophth. **25:** 1337 (Nov.) 1942.

Barlow reports a case of sarcoma of the choroid in a woman aged 32. The eye was enucleated twelve years later, after iridectomy for glaucoma, and the patient died seven years later of cerebral thrombosis. There was no clinical or postmortem evidence of metastasis. W. S. REESE.

MULTIPLE PRIMARY MALIGNANT NEOPLASM. M. K. ASBURY and D. VAIL, Am. J. Ophth. **26:** 688 (July) 1943.

The authors report a case of multiple malignant neoplasms, one an intraocular malignant melanoma of the choroid, and the other, which was the cause of death, a glioblastoma multiforme of the cerebrum. The neoplasm of the choroid was seen to develop from a nevus which had been under observation for three years before it began to increase in size.

The article is illustrated. W. ZENTMAYER.

Uvea

CHOROIDEREMIA. R. G. SCOBEE, Am. J. Ophth. **26:** 1135 (Nov.) 1943.

Scobee agrees with Bedell that choroideremia is postnatal pathologic dissolution, and not congenital absence of the choroid. He gives the following summary:

"Two typical cases of choroideremia, one in an early and the other in a late stage, are reported in brothers aged 18 and 24 years, who lacked a hereditary background for the condition. Both have remarkably good vision in view of the fundus changes present; one is myopic, the other hypermetropic. Choroid and retina are present only at the extreme periphery and at the macula in all fundi. Their fundus reflex is greenish-white in color. Bilateral annular scotomata are present in both cases, night blindness only in the more advanced one. The more advanced case has innumerable tiny pigment balls fixed to the vitreous framework, and the anterior vitreous fibrils appear striated; degenerative changes could be observed in the vitreous picture in 30 days' time. Both patients have an early bilateral nerve-type deafness. The vitreous findings in addition to the audiographic examination would seem to furnish further evidence that choroideremia is a degenerative process primarily and not a congenital defect. W. S. REESE.

Vision

THE TREATMENT OF AMBLYOPIA. F. B. FRALICK, Am. J. Ophth. **26:** 1195 (Nov.) 1943.

Fralick gives the following summary:

"The early recognition and treatment of amblyopia offers the greatest percentage of successful results. The entire field of orthoptic treatment is opened up for subsequent exploitation only through its successful correction. Those individuals obtaining and retaining acceptable industrial vision have a tremendous economic advantage. No amblyopic eye should be considered due to a congenital defect until all forms of occlusion therapy have been used continuously and totally for a period of several months without demonstrable visual improvement."

W. S. REESE.

Therapeutics

THE PRODUCTION AND TREATMENT OF EXPERIMENTAL PNEUMOCOCCAL HYPOPYON ULCERS IN THE RABBIT. J. M. ROBSON and G. I. SCOTT, Brit. J. Exper. Path. **24:** 50 (April) 1943.

A comparatively well standardized ulceration of the rabbit cornea, frequently accompanied by hypopyon, was produced by the intracorneal injection of Diplococcus pneumoniae type 19. The therapeutic effects of sodium penicillin (650 Oxford units per cubic centimeter), sodium sulfacetimide (30 per cent solution), sodium sulfapyridine (30 per cent solution) and tyrothricin (1 milligram per cubic centimeter) were studied. The antibacterial agents were instilled at various intervals for thirty-six hours. Thereafter the solutions were applied hourly during the day. Treatment was not continued beyond the fifth day.

The best results were achieved with the penicillin therapy. Even when treatment started twenty-four hours after inoculation, it was of some value. Sodium sulfacetimide had little effect when six hours had elapsed between inoculation and treatment but was highly beneficial in prevention of the ulceration when applied earlier.

The experiments with sodium sulfapyridine were discontinued after one series because of the conjunctival irritation after repeated instillations of the alkaline solution and because ulcerations could not be prevented even when treatment began one hour after inoculation. Tyrothricin was of possible slight benefit when treatment was started one hour after injection, but ulcers developed in all treated eyes.

L. VON SALLMANN.

Society Transactions

EDITED BY DR. W. L. BENEDICT

NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

FRANK C. KEIL, M.D., *Chairman*

WILLIS S. KNIGHTON, *Secretary*

Feb. 21, 1944

Lateral Proboscis with Cyclopean Eye: Further Report on a Case. DR. LOUISE H. MEEKER and DR. RUDOLPH AEBLI.

This paper will be published in full in a later issue of the ARCHIVES.

Intrinsic Variability of Astigmatic Errors. DR. JOSEPH I. PASCAL.

This paper will be published in full in a later issue of the ARCHIVES.

Differential Diagnosis of Paresis of the Right Superior Oblique Muscle and the Left Superior Rectus Muscle. DR. W. THORNWALL DAVIS, Washington, D. C.

This paper will be published in full, with discussion, in a later issue of the ARCHIVES.

Effects of High Altitude Flying and Deep Sea Diving on Ocular Function. CAPTAIN LEON D. CARSON (MC), U. S. N.

This paper will be published in full, with discussion, in a later issue of the ARCHIVES.

Book Reviews

Archivos de la Asociación para evitar la ceguera en México. Vol. I. Dr. L. Sánchez Bulnes, Editor in Chief. Pp. 173.

This, the first volume of the *Annals of the Mexican Society for the Prevention of Blindness,* has just appeared. After an introductory note by Dr. Baz, minister of public welfare, a history of the association is given by Dr. C. R. Margain. At a meeting of the section on ophthalmology of the National Medical Congress in 1918, Dr. J. de J. González urged the formation of the society, and it was legally incorporated in 1922. Originally supported by voluntary contributions, it was aided by a grant from President Calles in 1924 and grew from a small office for free consultations to the present hospital, which was opened in 1939, under the direction of Dr. L. Sánchez Bulnes. Further grants, amounting to more than $100,000, were made by the government in 1941. The endowment of the association, aside from its building, now amounts to some $125,000.

A statistical analysis of the work of the association in 1942 is presented by Drs. Daniel and Fernando Silva. The number of patients cared for was 13,410. In all, 24,507 treatments were given, 2,072 refractions carried out, 135 photographic studies of the external portion of the eye or the fundus made and 437 operations performed. Of the operations, 261 were performed on ambulatory patients, including 81 operations for pterygium. One hundred and eighty-six operations, including 112 extractions of cataracts, required hospitalization. The small number of operations for glaucoma (10) and for muscular anomalies (17) is noteworthy. Patients make voluntary donations for the services rendered according to their means, and these gifts, with the collections for glasses and drugs, amounted to $18,987, against the total of $30,599 expended, during the year. Twenty-five per cent of patients were unable to make any donations.

The ambulance service is described by Dr. J. Sáenz Canales. By means of a well fitted ambulance dispensary, with a staff of two doctors and a nurse, forty-five towns and villages outside the federal district were visited. Lectures on the care of the eyes and the prevention of blindness were given in schools and at public meetings of various sorts. Aid was given to local health officers in prophylaxis against ophthalmia neonatorum, and vials for the Credé treatment were dispensed. Consultations were held in various towns with the local general practitioners, who were advised as to the care of patients with simple conditions and were furnished with the necessary drugs. Refractions were carried out, the prescriptions being filled at the central hospital. Some minor operations were performed in the ambulance, while patients requiring hospitalization were sent to the central hospital, where treatment or operation was provided without cost. From 200 to 900 patients per month were seen by this ambulance team.

The scientific and clinical contributions included in the volume are as follows: "Retrocorneal Hyaline Trabeculae Following Interstitial Keratitis," by L. Sánchez Bulnes; "Cysts of the Vitreous," by J. Sánchez Canales; "Ocular Biomicrophotography," by M. de Rivas Cherif; "The Problem of Pupillary Occlusion," by H. Fernández Isassi; "An Intraocular Foreign Body," by R. Olivera López; "The Suture in Cataract Extraction," by Luis E. Martinez, and "A Case of Marcus Gunn's Phenomenon," by V. Ramirez Esteva.

It is planned to publish two numbers of the *Archivos* each year. The association is to be congratulated on the appearance and content of the volume, and especially on its record of remarkable achievement against many obstacles.

SANFORD R. GIFFORD, M.D.

A New Conception of Keratoconjunctivitis Sicca. By Henrik Sjögren, Jönköping, Sweden. English translation by Dr. J. Bruce Hamilton, Hobart, Tasmania. Pp. 152, with 56 illustrations. Price, 25 shillings. Glebe, Sydney, Australia: Australasian Medical Publishing Company, Ltd., 1943.

Dr. Hamilton's translation of Dr. Henrik Sjögren's monograph on keratoconjunctivitis sicca makes this important article now available to English readers. In a foreword are listed additional articles on this subject by the author and by others which have appeared since the publication of the monograph, in 1933; these articles have added little to knowledge of this syndrome. Dr. Hamilton believes that there are still several problems concerned with this subject which are open for investigation. These concern the pathologic picture of the arthritic condition; the blood count and sedimentation rate, which should be determined periodically; the bacterial content of the purulent salivary secretion; a quantitative analysis of the salivary secretion; a possible reaction to atrophic rhinitis and, finally, the relation of idiopathic corneal ulcer and diminished lacrimal secretion. At the end of the monograph, Dr. Hamilton has added an appendix dealing with treatment, about which nothing is said in the original article. Treatment,

which consists in occlusion of the canaliculi by electrocoagulation, has given good results in the hands of Beetham and Rucker. The preparation and instillation of artificial tears are described.

Dr. Hamilton tentatively concludes that there are two forms of keratitis sicca: The first, a true desiccation of the cornea with erosions, with or without filaments, is the more common and responds to electrocautery. The second, in which there is intermittent vesicular keratitis with attacks of arthritis or parotitis, responds only partially to such treatment. At the same time, treatment of the other manifestations of this symptom complex will not be satisfactory, since the etiologic factors require further research. The work of the translator has been well done, and the printing and the illustrations are clear and distinct. The abstracter draws attention to two recent articles which give an excellent review of this interesting topic (Bruce, G. M.: Keratoconjunctivitis Sicca, ARCH OPHTH. **26:** 945 [Dec.] 1941. Gifford, S. R.; Puntenney, I., and Bellows, J.: Keratoconjunctivitis Sicca, ibid. **30:** 207 [Aug.] 1943).

ARNOLD KNAPP.

Education and Health of the Partially Seeing Child. By Winifred Hathaway. Price, $2.50. Pp. 216. Published for the National Society for the Prevention of Blindness, Inc. New York: Columbia University Press, 1943.

The well known organization which has rendered a public service in pointing out and forestalling visual hazards widens still further the field of its activities. Recognizing the social and economic problem presented by a large number of visually handicapped children of school age, it has sponsored the present comprehensive and constructive survey. As its title indicates, this book deals with the health, as well as the education, of the partially seeing child. Intended for teachers, nurses, social service workers and others concerned with the welfare of the young, the material has been gathered from various sources in education, both lay and medical, and from industry, engineering and public health.

After reviewing the history of endeavor in this field, both here and abroad, the administrative responsibilities of classification, program planning and selection and training of teachers, Miss Hathaway discusses in detail the basic principles and technics of sight saving. These include the curriculum; the teaching of tool subjects, such as large type material (of which there is an unfortunate shortage), typewriting, chalk board writing, motivated art and hand work, as well as mechanical devices, such as recording machines, talking books and the radio. A special chapter is devoted to child guidance, individual and collective, in community social service and by civic organizations.

Among a number of appendixes, there is a useful one on the checking of lighting facilities and the installation of and equipment for ophthalmic work in the classroom.

The laudable character of this helpful undertaking and the excellent presentation of so important a subject are worthy of all praise and seem to disarm any but the most favorable criticism. However, from a sociologic standpoint, there are some misgivings as to the advisability, in many cases, of the undertaking of an education which is beyond the handicapped child's capacity, such as sending him to college and later, perhaps, to a professional school. Hopes may be aroused only to be met with frustration by inadequacies which are realized too late, and thus the original feeling of inferiority inherent in the visual handicap may be increased. As if this objection had been anticipated—if not foreseen—the psychologic, as well as the practical, approach to this serious problem is considered at length in a special chapter on prevocational and vocational guidance and training. In a well prepared and inspiring blueprint for the future of this service, entitled "The Road Ahead," the author has reviewed the results already accomplished by various agencies—medical and surgical, educational, socioeconomic and industrial—which have engaged in measures for sight saving in the widest sense, including that of community responsibility. The author appeals for even more extensive and active participation and cooperation in this campaign.

PERCY FRIDENBERG.

Directory of Ophthalmologic Societies *

INTERNATIONAL

International Association for Prevention of Blindness

President: Dr. P. Bailliart, 66 Boulevard Saint-Michel, Paris, 6e, France.
Secretary-General: Prof. M. Van Duyse, Université de Gand, Gand, Prov. Ostflandern, Belgium.
All correspondence should be addressed to the Secretariat, 66 Boulevard Saint-Michel, Paris, 6e, France.

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Presdient: Dr. C. H. Chou, 363 Avenue Haig, Shanghai.
Secretary: Dr. F. S. Tsang, 221 Foochow Rd., Shanghai.

Chinese Ophthalmological Society of Peiping

President: Dr. H. T. Pi, Peiping Union Medical College, Peiping.
Secretary: Dr. C. K. Lin, 180 Hsi-Lo-yen Chienmeng, Peiping.
Place: Peiping Union Medical College, Peiping. Time: Last Friday of each month.

German Ophthalmological Society

President: Prof. W. Lohlein, Berlin.
Secretary: Prof. E. Engelking, Heidelberg.

Hungarian Ophthalmological Society

President: Prof. I. Imre, Budapest.
Assistant Secretary: Dr. Stephen de Grósz, University Eye Hospital, Máriautca 39, Budapest.
All correspondence should be addressed to the Assistant Secretary.

Midland Ophthalmological Society

President: Dr. W. Niccol, 4 College Green, Gloucester, England.
Secretary: Mr. T. Harrison Butler, 61 Newhall St., Birmingham 3, England.
Place: Birmingham and Midland Eye Hospital.

North of England Ophthalmological Society

President: Dr. A. MacRae, 6 Jesmond Rd., Newcastle-upon-Tyne, England.
Secretary: Dr. Percival J. Hay, 350 Glossop Rd., Sheffield 10, England.
Place: Manchester, Bradford, Leeds, Newcastle-upon-Tyne, Liverpool and Sheffield, in rotation. Time: October to April.

Ophthalmological Society of Australia

President: Dr. A. James Flynn, 135 Macquarie St., Sydney.
Secretary: Dr. D. Williams, 193 Macquarie St., Sydney.

Ophthalmological Society of Egypt

President: Prof. Dr. Mohammed Mahfouz Bey, Government Hospital, Alexandria.
Secretary: Dr. Mohammed Khalil, 4 Baehler St., Cairo.
All correspondence should be addressed to the secretary, Dr. Mohammed Khalil.

Ophthalmological Society of the United Kingdom

President: Mr. T. Harrison Butler, 61 Newhall St., Birmingham 3, England.
Secretary: Mr. L. H. Savin, 7 Queen St., London, W. 1, England.

Ophthalmology Society of Bombay

President: Dr. D. D. Sathaye, 127 Girgaum Rd., Bombay 4, India.
Secretary: Dr. H. D. Dastur, Dadar, Bombay 14, India.
Place: H. B. A. Free Ophthalmic Hospital, Parel, Bombay 12. Time: First Friday of every month.

Oxford Ophthalmological Congress

Master: Mr. P. G. Doyne, 60 Queen Anne St., London, W. 1, England.
Secretary-Treasurer: Dr. F. A. Anderson, 12 St. John's Hill, Shrewsbury, England.
Place: Oxford, England. Time: July 8-9, 1943.

Palestine Ophthalmological Society

President: Dr. Arieh Feigenbaum, Abyssinian St. 15, Jerusalem.
Secretary: Dr. E. Sinai, Tel Aviv.

Polish Ophthalmological Society

President: Dr. W. Kapuściński, 2 Waly Batorego, Poznań.
Secretary: Dr. J. Sobański, Lindley'a 4, Warsaw.
Place: Lindley'a 4, Warsaw.

* Secretaries of societies are requested to furnish the information necessary to make this list complete and keep it up to date.

ROYAL SOCIETY OF MEDICINE, SECTION OF OPHTHALMOLOGY

President: Col. F. A. Juler, 96 Harley St., London, W. 1, England.
Secretary: Dr. Harold Ridley, 60 Queen Anne St., London, W. 1, England.

SÃO PAULO SOCIETY OF OPHTHALMOLOGY

President: Dr. W. Belfort Mattos, Caixa Postal, 4086, São Paulo, Brazil.
Secretary: Dr. Silvio de Almeida Toledo, Enfermaria Santa Luzia, Santa Casa de Misericordia, Cesario Motta, St. 112, São Paulo, Brazil.

SOCIEDAD ARGENTINA DE OFTALMOLOGIA

Chairman: Dr. Jorge Malbrán, Buenos Aires.
Secretary: Dr. Benito Just Tiscornia, Santa Fe 1171, Buenos Aires.

SOCIEDAD OFTALMOLOGIA DEL LITORAL, ROSARIO (ARGENTINA)

President: Prof. Dr. Carlos Weskamp, Laprida 1159, Rosario.
Secretary: Dr. Juan M. Vila Ortiz, Córdoba 1433, Rosario.
Place: Rosario. Time: Last Saturday of every month, April to November, inclusive. All correspondence should be addressed to the President.

SOCIEDADE DE OPHTHALMOLOGIA E OTO-RHINO-LARYNGOLOGIA DA BAHIA

President: Dr. Theonilo Amorim, Barra Avenida, Bahia, Brazil.
Secretary: Dr. Adroaldo de Alencar, Brazil.
All correspondence should be addressed to the President.

SOCIETÀ OFTALMOLOGICA ITALIANA

President: Prof. Dott. Giuseppe Ovio, Ophthalmological Clinic, University of Rome, Rome.
Secretary: Prof. Dott. Epimaco Leonardi, Via del Gianicolo, 1, Rome.

SOCIÉTÉ FRANÇAISE D'OPHTALMOLOGIE

Secretary: Dr. René Onfray, 6 Avenue de la Motte Picquet, Paris, 7e.

SOCIETY OF SWEDISH OPHTHALMOLOGISTS

President: Prof. K. G. Ploman, Stockholm.
Secretary: Dr. K. O. Granström, Södermalmstorg 4 III tr., Stockholm, Sö.

TEL AVIV OPHTHALMOLOGICAL SOCIETY

President: Dr. D. Arieh-Friedman, 96 Allenby St., Tel Aviv, Palestine.
Secretary: Dr. Sadger Max, 9 Bialik St., Tel Aviv, Palestine.

NATIONAL

AMERICAN MEDICAL ASSOCIATION, SCIENTIFIC ASSEMBLY, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Conrad Berens, 35 E. 70th St., New York City.
Secretary: Dr. R. J. Masters, 23 E. Ohio St., Indianapolis.
Place: Chicago. Time: June 12-16, 1944.

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY, SECTION ON OPHTHALMOLOGY

President: Dr. Lawrence T. Post, Metropolitan Bldg., St. Louis.
President-Elect: Dr. Gordon B. New, Mayo Clinic, Rochester, Minn.
Executive Secretary-Treasurer: Dr. William L. Benedict, 101–1st Ave. Bldg., Rochester, Minn.

AMERICAN OPHTHALMOLOGICAL SOCIETY

President: Dr. John Green, 3720 Washington Ave., St. Louis.
Secretary-Treasurer: Dr. Walter S. Atkinson, 129 Clinton St., Watertown, N. Y.
Place: Hot Springs, Va. Time: May 29-31, 1944.

ASSOCIATION FOR RESEARCH IN OPHTHALMOLOGY, INC.

Chairman: Dr. Frederick C. Cordes, 384 Post St., San Francisco.
Secretary-Treasurer: Major Brittain F. Payne, School of Aviation Medicine, Randolph Field, Texas.

CANADIAN MEDICAL ASSOCIATION, SECTION ON OPHTHALMOLOGY

President: Dr. Alexander E. MacDonald, 170 St. George St., Toronto.
Secretary-Treasurer: Dr. L. J. Sebert, 170 St. George St., Toronto.

CANADIAN OPHTHALMOLOGICAL SOCIETY

President: Dr. R. Evatt Mathers, 34½ Morris St., Halifax, N. S.
Secretary-Treasurer: Dr. Kenneth B. Johnston, Suite 1, 1509 Sherbrooke St. W., Montreal.
Place: Halifax, N. S. Time: Aug. 4-5, 1944.

NATIONAL SOCIETY FOR THE PREVENTION OF BLINDNESS

President: Mr. Mason H. Bigelow, 1790 Broadway, New York.
Secretary: Miss Regina E. Schneider, 1790 Broadway, New York.
Executive Director: Mrs. Eleanor Brown Merrill, 1790 Broadway, New York.

SECTIONAL

ACADEMY OF MEDICINE OF NORTHERN NEW JERSEY, SECTION ON EYE, EAR, NOSE AND THROAT

President: Dr. N. Zwaifler, 46 Wilbur Ave., Newark.
Secretary: Dr. William F. Keim Jr., 25 Roseville Ave., Newark.
Place: 91 Lincoln Park South, Newark. Time: 8:45 p. m., second Monday of each month, October to May.

CENTRAL WISCONSIN SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. L. J. Friend, 425 E. Grand Ave., Beloit, Wis.
Secretary: Dr. G. L. McCormick, 626 S. Central Ave., Marshfield.

NEW ENGLAND OPHTHALMOLOGICAL SOCIETY

President: Dr. Paul A. Chandler, 5 Bay State Rd., Boston.
Secretary-Treasurer: Dr. Merrill J. King, 264 Beacon St., Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

Pacific Coast Oto-Ophthalmological Society

President: Dr. D. H. O'Rourke, 1612 Tremont Pl., Denver.
Secretary-Treasurer: Dr. C. Allen Dickey, 450 Sutter St., San Francisco.

Puget Sound Academy of Ophthalmology and Oto-Laryngology

President: Dr. L. L. McCoy, 1317 Marion St., Seattle, Wash.
Secretary-Treasurer: Dr. Barton E. Peden, 301 Stimson Bldg., Seattle.
Place: Seattle or Tacoma, Wash. Time: Third Tuesday of each month except June, July and August.

Rock River Valley Eye, Ear, Nose and Throat Society

President: Dr. J. Sheldon Clark, 27 E. Stephenson St., Freeport, Ill.
Secretary-Treasurer: Dr. Harry R. Warner, 321 W. State St., Rockford, Ill.
Place: Rockford, Ill., or Janesville or Beloit, Wis. Time: Third Tuesday of each month from October to April, inclusive.

Saginaw Valley Academy of Ophthalmology and Otolaryngology

President: Dr. M. H. Pike, Midland, Mich.
Secretary-Treasurer: Dr. R. H. Criswell, 407 Phoenix Bldg., Bay City, Mich.
Place: Saginaw or Bay City, Mich. Time: Second Tuesday of each month, except July and August.

Sioux Valley Eye and Ear Academy

President: Dr. J. C. Decker, 515 Francis Bldg., Sioux City, Iowa.
Secretary-Treasurer: Dr. J. E. Dvorak, 408 Davidson Bldg., Sioux City, Iowa.

Southern Medical Association, Section on Eye, Ear, Nose and Throat

Chairman: Dr. John H. Burleson, 414 Navarro St., San Antonio, Texas.
Secretary: Dr. J. W. Jervey Jr., 101 Church St., Greenville, S. C.

Southwestern Academy of Eye, Ear, Nose and Throat

President: Dr. H. L. Brehmer, 221 W. Central Ave., Albuquerque, N. Mex.
Secretary: Dr. A. E. Cruthirds, 1011 Professional Bldg., Phoenix, Ariz.

Southwestern Michigan Triological Society

President: Dr. W. M. Dodge, 716 First National Bank Bldg., Battle Creek.
Secretary-Treasurer: Dr. Kenneth Lowe, 25 W. Michigan Ave., Battle Creek.
Time: Last Thursday of September, October, November, March, April and May.

Western Pennsylvania Eye, Ear, Nose and Throat Society

President: Dr. Ray Parker, 218 Franklin St., Johnston, Pa.
Secretary-Treasurer: Dr. J. McClure Tyson, Deposit Nat'l Bank Bldg., DuBois.

STATE

Arkansas State Medical Society, Eye, Ear, Nose and Throat Section

President: Dr. Raymond C. Cook, 701 Main St., Little Rock.
Secretary: Dr. K. W. Cosgrove, Urquhart Bldg., Little Rock.

Colorado Ophthalmological Society

President: Dr. C. A. Ringle, 912–9th Ave., Greeley.
Secretary: Dr. W. A. Ohmart, 1102 Republic Bldg., Denver.
Place: University Club, Denver. Time: 7:30 p. m., third Saturday of each month, October to May, inclusive.

Connecticut State Medical Society, Section on Eye, Ear, Nose and Throat

President: Dr. F. L. Phillips, 405 Temple St., New Haven.
Secretary-Treasurer: Dr. W. H. Turnley, 1 Atlantic St., Stamford, Conn.

Eye, Ear, Nose and Throat Club of Georgia

President: Dr. E. N. Maner, 247 Bull St., Savannah.
Secretary-Treasurer:: Dr. C. K. McLaughlin, 567 Walnut St., Macon.

Indiana Academy of Ophthalmology and Oto-Laryngology

President: Dr. F. McK. Ruby, Union City.
Secretary: Dr. Edwin W. Dyar Jr., 23 E. Ohio St., Indianapolis.
Place: French Lick. Time: First Wednesday in April.

Iowa Academy of Ophthalmology and Oto-Laryngology

President: Dr. J. K. Von Lackum, 117–3d St. S. E., Cedar Rapids.
Secretary-Treasurer: Dr. B. M. Merkel, 604 Locust St., Des Moines.

Louisiana-Mississippi Ophthalmological and Otolaryngological Society

President: Dr. Val H. Fuchs, 200 Carondelet St., New Orleans.
Secretary-Treasurer: Dr. Edley H. Jones, 1301 Washington St., Vicksburg, Miss.

Michigan State Medical Society, Section of Ophthalmology and Otolaryngology

Chairman: Dr. Robert H. Fraser, 25 W. Michigan Ave., Battle Creek.
Secretary: Dr. R. G. Laird, 114 Fulton St., Grand Rapids.

Minnesota Academy of Ophthalmology and Otolaryngology

President: Dr. George E. McGeary, 920 Medical Arts Bldg., Minneapolis.
Secretary: Dr. William A. Kennedy, 372 St. Peter St., St. Paul.
Time: Second Friday of each month from October to May.

Montana Academy of Oto-Ophthalmology

President: Dr. William Morrison, 208 N. Broadway, Billings, Mont.
Secretary: Dr. Fritz D. Hurd, 309 Medical Arts Bldg., Great Falls.

Nebraska Academy of Ophthalmology and Otolaryngology

President: Dr. W. Howard Morrison, 1500 Medical Arts Bldg., Omaha.
Secretary-Treasurer: Dr. John Peterson, 1307 N St., Lincoln.

New Jersey State Medical Society, Section on Ophthalmology, Otology and Rhinolaryngology

Chairman: Dr B. E. Failing, 31 Lincoln Park, Newark.
Secretary: Dr. George Meyer, 410 Haddon Ave., Camden.

New York State Medical Society, Eye, Ear, Nose and Throat Section

Chairman: Dr. James E. McAskill, 508 Woolworth Bldg., Watertown.
Secretary: Dr. Harold J. Joy, 504 State Tower Bldg., Syracuse 2.

North Carolina Eye, Ear, Nose and Throat Society

President: Dr. Hugh C. Wolfe, 102 N. Elm St., Greensboro.
Secretary: Dr. Vanderbilt F. Couch, 104 W. 4th St., Winston-Salem.

North Dakota Academy of Ophthalmology and Oto-Laryngology

President: Dr. T. W. Buckingham, 405 Broadway, Bismarck.
Secretary-Treasurer: Dr. F. L. Wicks, 516–6th St., Valley City.

Oregon Academy of Ophthalmology and Oto-Laryngology

President: Dr. Paul Neely, 1020 S. W. Taylor St., Portland.
Secretary-Treasurer: Dr. Lewis Jordon, 1020 S. W. Taylor St., Portland.
Place: Good Samaritan Hospital, Portland. Time: Third Tuesday of each month.

Rhode Island Ophthalmological and Otological Society

Acting President: Dr. N. Darrell Harvey, 112 Waterman St., Providence.
Secretary-Treasurer: Dr. Linley C. Happ, 124 Waterman St., Providence.
Place: Rhode Island Medical Society Library, Providence. Time: 8:30 p. m., second Thursday in October, December, February and April.

South Carolina Society of Ophthalmology and Otolaryngology

President: Dr. J. L. Sanders, 222 N. Main St., Greenville.
Secretary: Dr. J. H. Stokes, 125 W. Cheves St., Florence.

Tennessee Academy of Ophthalmology and Otolaryngology

President: Dr. Wesley Wilkerson, 700 Church St., Nashville.
Secretary-Treasurer: Dr. W. D. Stinson, 124 Physicians and Surgeons Bldg., Memphis.

Texas Ophthalmological and Oto-Laryngological Society

President: Dr. F. H. Rosebrough, 603 Navarro St., San Antonio.
Secretary: Dr. M. K. McCullough, 1717 Pacific Ave., Dallas.

Utah Ophthalmological Society

President: Dr. R. B. Maw, 699 E. South Temple, Salt Lake City.
Secretary-Treasurer: Dr. Charles Ruggeri Jr., 1120 Boston Bldg., Salt Lake City.
Place: University Club, Salt Lake City. Time: 7:00 p. m., third Monday of each month.

Virginia Society of Oto-Laryngology and Ophthalmology

President: Dr. Mortimer H. Williams, 30½ Franklin Rd. S. W., Roanoke.
Secretary-Treasurer: Dr. Meade Edmunds, 34 Franklin St., Petersburg.

West Virginia State Medical Association, Eye, Ear, Nose and Throat Section

President: Dr. George Traugh, 309 Cleveland Ave., Fairmont.
Secretary: Dr. Welch England, 621½ Market St., Parkersburg.

LOCAL

Akron Academy of Ophthalmology and Otolaryngology

President: Dr. E. L. Mather, 39 S. Main St., Akron, Ohio.
Secretary-Treasurer: Dr. V. C. Malloy, 2d National Bank Bldg., Akron, Ohio.
Time: First Monday in January, March, May and November.

Atlanta Eye, Ear, Nose and Throat Society

President: Dr. B. M. Cline, 153 Peachtree St. N. E., Atlanta, Ga.
Acting Secretary: Dr. A. V. Hallum, 478 Peachtree St. N. E., Atlanta, Ga.
Place: Grady Hospital. Time: 6:00 p. m., fourth Monday of each month, from October to May.

Baltimore Medical Society, Section on Ophthalmology

Chairman: Dr. Ernst Bodenheimer, 1212 Eutaw Pl., Baltimore.
Secretary: Dr. Thomas R. O'Rourk, 104 W. Madison St., Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to March.

Birmingham Eye, Ear, Nose and Throat Club

President: Each member, in alphabetical order.
Secretary: Dr. Luther E. Wilson, 919 Woodward Bldg., Birmingham, Ala.
Place: Tutwiler Hotel. Time: 6:30 p. m., second Tuesday of each month, September to May, inclusive.

Brooklyn Ophthalmological Society

President: Dr. William B. Agan, 1 Nevins St., Brooklyn.
Secretary-Treasurer: Dr. Benjamin C. Rosenthal, 140 New York Ave., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday in February, April, May, October and December.

Buffalo Ophthalmologic Club

President: Dr. Walter F. King, 519 Delaware Ave., Buffalo.
Secretary-Treasurer: Dr. Sheldon B. Freeman, 196 Linwood Ave., Buffalo.
Time: Second Thursday of each month.

Chattanooga Society of Ophthalmology and Otolaryngology

President: Each member, in alphabetical order.
Secretary: Dr. Douglas Chamberlain, Chattanooga Bank Bldg., Chattanooga, Tenn.
Place: Mountain City Club. Time: Second Thursday of each month from September to May.

Chicago Ophthalmological Society

President: Dr. Vernon M. Leech, 55 E. Washington St., Chicago.
Secretary: Dr. W. A. Mann, 30 N. Michigan Ave., Chicago.
Place: Chicago Towers Club, 505 N. Michigan Ave. Time: Third Monday of each month from October to May.

Cincinnati General Hospital Ophthalmology Staff

Chairman: Dr. D. T. Vail, 441 Vine St., Cincinnati.
Secretary: Dr. A. A. Levin, 441 Vine St., Cincinnati.
Place: Cincinnati General Hospital. Time: 7:45 p. m., third Friday of each month except June, July and August.

Cleveland Ophthalmological Club

Chairman: Dr. Shandor Monson, 1621 Euclid Ave., Cleveland.
Secretary: Dr. Carl Ellenberger, 14805 Detroit Ave., Cleveland.
Time: Second Tuesday in October, December, February and April.

College of Physicians, Philadelphia, Section on Ophthalmology

Chairman: Dr. W. S. Reese, 1901 Walnut St., Philadelphia.
Clerk: Dr. George F. J. Kelly, 37 S. 20th St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

Columbus Ophthalmological and Oto-Laryngological Society

Chairman: Dr. H. D. Emswiler, 370 E. Town St., Columbus, Ohio.
Secretary-Treasurer: Dr. D. G. Sanor, 206 E. State St., Columbus, Ohio.
Place: The Neil House. Time: 6 p. m., first Monday of each month.

Corpus Christi Eye, Ear, Nose and Throat Society

Chairman: Dr. Arthur Padillo, 414 Medical Professional Bldg., Corpus Christi, Texas.
Secretary: Dr. Edgar G. Mathis, 815 Medical Arts Bldg., Corpus Christi, Texas.
Time: Second Friday of each month from October to May.

Dallas Academy of Ophthalmology and Oto-Laryngology

President: Dr. Abell Hardin, Medical Arts Bldg., Dallas, Texas.
Secretary: Dr. Ruby K. Daniel, Medical Arts Bldg., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6:30 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Des Moines Academy of Ophthalmology and Otolaryngology

President: Dr. H. C. Schmitz, 604 Locust St., Des Moines, Iowa.
Secretary-Treasurer: Dr. Byron M. Merkel, 604 Locust St., Des Moines, Iowa.
Time: 7:45 p. m., third Monday of every month from September to May.

Detroit Ophthalmological Club

Chairman: Dr. Howell L. Begle, 2730 E. Jefferson Ave., Detroit.
Secretary: Dr. C. W. Lepard, 1025 David Whitney Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month, November through April.

Detroit Ophthalmological Society

President: Dr. Parker Heath, 1553 Woodward Ave., Detroit.
Secretary: Dr. Leland F. Carter, 1553 Woodward Ave., Detroit.
Place: Club rooms of Wayne County Medical Society. Time: Third Thursday of each month from November to April, inclusive.

Eastern New York Eye, Ear, Nose and Throat Association

President: Appointed at each meeting.
Secretary-Treasurer: Dr. Joseph L. Holohan, 330 State St., Albany.
Time: Third Wednesday in October, November, March, April, May and June.

Eastern Pennsylvania Association of Eye, Ear, Nose and Throat Physicians

President: Dr. James E. Landis, 232 N. 6th St., Reading.
Secretary-Treasurer pro tem: Dr. Paul C. Craig, 232 N. 5th St., Reading.
Time: Last week in April each year.

Fort Worth Eye, Ear, Nose and Throat Society

President: Dr. Rex Howard, 602 W. 10th St., Fort Worth, Texas.
Secretary-Treasurer: Dr. R. H. Gough, Medical Arts Bldg., Fort Worth, Texas.
Place: Medical Hall, Medical Arts Bldg. Time: 7:30 p. m., first Friday of each month except July and August.

HOUSTON ACADEMY OF MEDICINE, OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SECTION

President: Dr. Lyle J. Logue, 1304 Walker Ave., Houston, Texas.
Secretary: Dr. John T. Stough, 803 Medical Arts Bldg., Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., second Thursday of each month from September to June.

INDIANAPOLIS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. Myron Harding, 23 E. Ohio St., Indianapolis.
Secretary: Dr. Kenneth L. Craft, 23 E. Ohio St., Indianapolis.
Place: Indianapolis Athletic Club. Time: 6:30 p. m., second Thursday of each month from November to May.

KANSAS CITY SOCIETY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Edgar Johnson, 906 Grand Ave., Kansas City, Mo.
Secretary: Dr. W. E. Keith, 1103 Grand Ave., Kansas City, Mo.
Time: Third Thursday of each month from October to June. The November, January and March meetings are devoted to clinical work.

LONG BEACH EYE, EAR, NOSE AND THROAT SOCIETY

Chairman: Dr. Harold Snow, 614 S. Pacific Ave., San Pedro, Calif.
Secretary-Treasurer: Dr. Oliver R. Nees, 508 Times Bldg., Long Beach, Calif.
Place: Professional Bldg. Time: Last Wednesday of each month from October to May.

LOS ANGELES SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. M. E. Trainor, 523 W. 6th St., Los Angeles.
Secretary-Treasurer: Dr. Orrie E. Ghrist, 210 N. Central Ave., Glendale, Calif.
Place: Los Angeles County Medical Association Bldg., 1925 Wilshire Blvd. Time: 6:00 p. m., fourth Monday of each month from September to May, inclusive.

LOUISVILLE EYE AND EAR SOCIETY

President: Dr. Joseph S. Heitger, Heyburn Bldg., Louisville, Ky.
Secretary-Treasurer: Dr. J. W. Fish, 321 W. Broadway, Louisville, Ky.
Place: Brown Hotel. Time. 6:30 p. m., second Thursday of each month from September to May, inclusive.

LOWER ANTHRACITE EYE, EAR, NOSE AND THROAT SOCIETY

Chairman: Each member in alphabetical order.
Secretary: Dr. James J. Monohan, 31 S. Jardin St., Shenandoah, Pa.

MEDICAL SOCIETY OF THE DISTRICT OF COLUMBIA, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. P. S. Constantinople, 1835 I St. N. W., Washington.
Secretary: Dr. Frazier Williams, 1801 I St. N. W., Washington.
Place: 1718 M St. N. W. Time: 8 p. m., third Friday of each month from October to April, inclusive.

MEMPHIS SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Each member in alphabetical order.
Secretary: Dr. Sam H. Sanders, 1089 Madison Ave., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month from September to May.

MILWAUKEE OTO-OPHTHALMIC SOCIETY

President: Dr. Edwin C. Bach, 324 E. Wisconsin Ave., Milwaukee.
Secretary-Treasurer: Dr. Ralph T. Rank, 238 W. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6:30 p. m., second Tuesday of each month.

MONTGOMERY COUNTY MEDICAL SOCIETY

Chairman: Dr. H. V. Dutrow, 1040 Fidelity Medical Bldg., Dayton, Ohio.
Secretary-Treasurer: Dr. Maitland D. Place, 981 Reibold Bldg., Dayton, Ohio.
Place: Van Cleve Hotel. Time: 6:30 p. m., first Tuesday of each month from October to June, inclusive.

MONTREAL OPHTHALMOLOGICAL SOCIETY

President: Dr. J. Rosenbaum, 1396 Ste. Catherine St. W., Montreal, Canada.
Secretary: Dr. L. Tessier, 1230 St. Joseph Blvd. E., Montreal, Canada.
Time: Second Thursday of October, December, February and April.

NASHVILLE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. M. M. Cullom, 700 Church St., Nashville, Tenn.
Secretary: Dr. R. E. Sullivan, 432 Doctors Bldg., Nashvile, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month from October to May

NEW HAVEN OPHTHALMOLOGICAL SOCIETY

President: Dr. William H. Ryder, 185 Church St., New Haven, Conn.
Secretary: Dr. Frederick A. Wiess, 255 Bradley St., New Haven, Conn.

NEW ORLEANS OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETY

President: Dr. W. B. Clark, 1012 American Bank Bldg., New Orleans.
Secretary: Dr. Mercer G. Lynch, 1018 Maison Blanche Bldg., New Orleans.
Place: Louisiana State University Medical Bldg. Time: 8 p. m., second Tuesday of each month from October to May.

New York Academy of Medicine, Section of Ophthalmology

Chairman: Dr. Frank C. Keil, 660 Madison Ave., New York.
Secretary: Dr. Willis S. Knighton, 121 E. 61st St., New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

New York Society for Clinical Ophthalmology

President: Dr. Sigmund Agatston, 875–5th Ave., New York.
Secretary: Dr. Benjamin Esterman, 983 Park Ave., New York.
Place: Squibb Hall, 745–5th Ave. Time: 8 p. m., first Monday of each month from October to May, inclusive.

Oklahoma City Academy of Ophthalmology and Otolaryngology

President: Dr. James P. Luton, 117 N. Broadway, Oklahoma City.
Secretary: Dr. Harvey O. Randel, 117 N. Broadway, Oklahoma City.
Place: University Hospital. Time: Second Tuesday of each month from September to May.

Omaha and Council Bluffs Ophthalmological and Oto-Laryngological Society

President: Dr. D. D. Stonecypher, Nebraska City, Neb.
Secretary-Treasurer: Dr. W. Howard Morrison, 1500 Medical Arts Bldg., Omaha.
Place: Omaha Club, 20th and Douglas Sts., Omaha. Time: 6 p. m. dinner; 7 p. m. program; third Wednesday of each month from October to May.

Passaic-Bergen Ophthalmological Club

President: Dr. Thomas Sanfacon, 340 Park Ave., Paterson, N. J.
Secretary-Treasurer: Dr. J. Averbach, 435 Clinton Ave., Clinton, N. J.
Place: Paterson Eye and Ear Infirmary. Time: 9 p. m., last Friday of every month, except June, July and August.

Philadelphia County Medical Society, Eye Section

President: Dr. Wilfred E. Fry, 1819 Chestnut St., Philadelphia.
Secretary: Dr. Glen Gregory Gibson, 255 S. 17th St., Philadelphia.
Time: First Thursday of each month from October to May.

Pittsburgh Ophthalmological Society

President: Dr. John B. McMurray, 6 S. Main St., Washington, Pa.
Secretary: Dr. George H. Shuman, 351–5th Ave., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

Reading Eye, Ear, Nose and Throat Society

President: Dr. R. M. Brickbauer, Shillington, Pa.
Secretary: Dr. Paul C. Craig, 232 N. 5th St., Reading, Pa.
Place: Wyomissing Club. Time: 6:30 p. m., third Wednesday of each month from October to July.

Richmond Ophthalmological and Oto-Laryngological Society

President: Dr. Peter N. Pastore, Medical College of Virginia, Richmond, Va.
Secretary: Dr. Clifford A. Folkes, Professional Bldg., Richmond, Va.
Place: Westmoreland Club. Time: 6 p. m., second Monday of each month from October to May.

Rochester Eye, Ear, Nose and Throat Society

President: Dr. Frank Barber, 75 S. Fitzhugh St., Rochester, N. Y.
Secretary-Treasurer: Dr. Charles T. Sullivan, 277 Alexander St., Rochester, N. Y.

St. Louis Ophthalmic Society

President: Dr. C. C. Beisbarth, 3720 Washington Blvd., St. Louis.
Secretary: Dr. H. R. Hildreth, 508 N. Grand Blvd., St. Louis.
Place: Oscar Johnson Institute. Time: Clinical meeting, 5:30 p. m., dinner and scientific meeting 6:30 p. m., fourth Friday of each month from October to April, inclusive, except December.

San Antonio Ophthalmo-Oto-Laryngological Society

President: Dr. Belvin Pritchett, 705 E. Houston St., San Antonio 5, Texas.
Secretary-Treasurer: Lt. Col. John L. Matthews, AAF School of Aviation Medicine, Randolph Field, Texas.
Place: San Antonio, Brooke General Hospital, Randolph Field or San Antonio Aviation Cadet Center. Time: 7 p. m., second Tuesday of each month from October to May.

San Francisco County Medical Society, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Roy H. Parkinson, 870 Market St., San Francisco.
Secretary: Dr. A. G. Rawlins, 384 Post St., San Francisco.
Place: Society's Bldg., 2180 Washington St., San Francisco. Time: Fourth Tuesday of every month except June, July and December.

Shreveport Eye, Ear, Nose and Throat Society

President: Dr. David C. Swearingen, Slattery Bldg., Shreveport, La.
Secretary-Treasurer: Dr. Kenneth Jones, Medical Arts Bldg., Shreveport, La.
Place: Shreveport Charity Hospital. Time: 7:30 p. m., first Monday of every month except July, August and September.

Spokane Academy of Ophthalmology and Oto-Laryngology

President: Dr. Clarence A. Veasey Sr., 421 W. Riverside Ave., Spokane, Wash.
Secretary: Dr. Clarence A. Veasey Jr., 421 W. Riverside Ave., Spokane, Wash.
Place: Spokane Medical Library. Time: 8 p. m., fourth Tuesday of each month except June, July and August.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. A. H. Rubenstein, 713 E. Genesee St., Syracuse, N. Y.
Secretary-Treasurer: Dr. I. H. Blaisdell, 713 E. Genesee St., Syracuse, N. Y.
Place: University Club. Time: First Tuesday of each month except June, July and August.

Toledo Eye, Ear, Nose and Throat Society

Chairman: Dr. E. W. Campbell, 316 Michigan St., Toledo, Ohio.
Secretary: Dr. L. C. Ravin, 316 Michigan St., Toledo, Ohio.
Place: Toledo Club. Time: Each month except June, July and August.

Toronto Academy of Medicine, Section of Ophthalmology

Chairman: Dr. W. R. F. Luke, 316 Medical Arts Bldg., Toronto, Canada.
Secretary: Dr. W. T. Gratton, 216 Medical Arts Bldg., Toronto, Canada.
Place: Academy of Medicine, 13 Queens Park. Time: First Monday of each month, November to April.

Washington, D. C., Ophthalmological Society

President: Dr. S. Bockoven, 1752 Massachusetts Ave., Washington, D. C.
Secretary-Treasurer: Dr. John Lloyd, 1218–16th St. N. W., Washington, D. C.
Place: Medical Society of District of Columbia Bldg., 1718 M St. N. W., Washington, D. C. Time: 7:30 p. m., first Monday in November, January, March and May.

Wilkes-Barre Ophthalmological Society

Chairman: Each member in turn.
Secretary: Dr. Samuel T. Buckman, 70 S. Franklin St., Wilkes-Barre, Pa.
Place: Office of chairman. Time: Last Tuesday of each month from October to May.